BUSINESS MANAGEMENT

Training and Service for Executive Work

*Control thru Planning ** Control thru Costs*

LA SALLE EXTENSION
UNIVERSITY
CHICAGO

BUSINESS MANAGEMENT

Executive Manuals 37 and 38

CONTROL THRU PLANNING—Being Executive Manual 37, on Principles of Production, in a Complete Plan of Training and Service for Executive Work

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CONTENTS

CONTROL THRU PLANNING

Part I

APPLYING SCIENTIFIC PLANNING

Page
What Planning Will Do 2
What Planning Involves 3
Planning and the General Policies 4
Planning and Standards 5
Standardization As an Aid in Control........................ 6
Production Planning 8
Control thru Planning...................................... 9
The Planning Department................................... 11
Activities of a Modern Planning Department.................. 13
Production Orders and Preparation in the Small Shop.......... 17
Scheduling the Work....................................... 18
Planning When Work Will Be Completed...................... 19
Dispatch Boards 20
Control Boards 22
How Control Boards Are Used............................... 23
Adaptations of the Control-Board Idea....................... 26
Checking and Following up the Work........................ 27
Does Planning Mean Additional Nonproductive Labor?........ 30
Does a Planning Department Do Nothing but Plan?........... 31

Part II

THE PART THAT COSTS PLAY

The Need of Accurate Costs................................ 33
The Benefits of a Cost System.............................. 35
Wastes Are Disclosed...................................... 35
Shows Costs of Individual Items and Parts................... 36
Acts as a Basis in Determining Selling Prices................. 36
Provides Basis for Standard Unit Costs...................... 37
Provides Valuable Comparisons............................. 37
Assists in Determining Taxes............................... 38
Acts As a Basis for Planning................................ 38
Guides Company Policy.................................... 39
Classification of Costs..................................... 40
The Elements of Costs..................................... 40
Cost As a Basis of Selling Price............................ 42
The Importance of Departmental Cost Analysis............... 43
Fitting Costs into the General Accounts...................... 44
Cost Accounting As a Branch of Accounting.................. 45
CHECK-UP ON PRINCIPLES................................ 47
"WHEN CAN WE MAKE DELIVERY?"—EXECUTIVE PROBLEM 37 51
APPENDIX — COST ACCOUNTING AND THE GENERAL ACCOUNTS 55

CONTROL THRU PLANNING

Part I

APPLYING SCIENTIFIC PLANNING

MR. DAVIS, president of a manufacturing company, arranged to see Mr. Jones, an industrial engineer, at 9:30 o'clock on Monday morning.

Mr. Jones is there at 9:30, but the president's secretary tells him that Mr. Davis has not yet come in. She does not know just when he will, nor what his plans are for the day.

Mr. Jones waits.

A bank messenger comes in with a sight draft for $2,321 attached to a bill of lading. The girl at the information desk asks him to wait, while the general manager and the treasurer confer about the sight draft. The treasurer says that he could have had funds to meet the draft had be been told about it in advance. The general manager insists that he must have immediate delivery of this shipment of parts in order to complete some overdue machinery.

The bank's messenger is told that the treasurer will call at the bank during the day. Mr. Jones still waits.

A salesman enters and slam-bangs his way into his sales manager's office.

"What luck?—No luck at all!" booms the salesman's voice. "Both those dealers in Joplin are off at the state convention in St. Louis.

"Why did you send me to Joplin yesterday? I should have been in St. Louis."

Mr. Jones finally tires of waiting for the president. Leaving the office, he looks into the shop. There he sees the foreman arguing with a machinist and his helper over a blue print. The machinist evidently wants to use one lathe for a job and the foreman thinks another would be better.

As they argue, another machinist walks up, blue print in hand, and waits for an opening. The foreman finally turns to him. The machinist asks whether it would not be better to drill the base plate for ¾-inch bolts instead of ⅝-inch since Jimmy (the stock-room boy) told him there were no ⅝-inch bolts in stock.

Before this question is settled, the order clerk hurries in and wants to know when those No. 7 jointer shafts will be ready. The machines are all ready for assembling, but they cannot proceed without the shafts.

The order clerk is told that the shafts will not be ready for a week. He points out that the job now on the No. 3 lathe is not as important as the jointer job. Another argument begins.

What Planning Will Do. Mr. Jones has seen and heard enough. He shrugs his shoulders and says to himself as he walks away that this company cannot stay in business much longer unless they undertake to plan their various activities more definitely.

He finds, during his interview later with the president, that his observations prove to be very convincing.

He knows that, if this company had developed control thru scientific planning, the treasurer would have anticipated the sight draft and provided funds to meet it; the sales manager would not have sent the salesman to Joplin on that day; while in the shop, the work would have been properly scheduled and there would have been no arguments and delays.

All necessary materials would have been planned in advance; the machines to be used for each job would have been definitely assigned, and authority for each decision would have been definitely placed on some responsible executive.

Confusion and delays—leaks of time, of profit, and of prestige—can be avoided by careful planning, which is a prime essential of efficient management.

This applies to the small as well as to the large organization. Effective planning, in fact, is a relatively simple matter for the small organization. Yet there are cases of utter lack of planning, such as that observed by Mr. Jones.

Planning is of pre-eminent importance in every business. Appreciation of the importance of planning, understanding of the methods and principles of planning, and ability to plan based upon that knowledge are essential to success in all business management.

Let us first make sure that we understand exactly what is involved in planning.

What Planning Involves. Comprehensive planning is more than having definite purposes or determining company policies. Planning calls for constructive imagination to foresee possible results, and to determine in advance exactly how those results can be attained. It requires ability to turn from the broad consideration of a question which reveals the principles involved to detailed decisions that are necessary in applying these principles. In involves the painstaking study that is necessary in determining with certainty just what to do and just how to do it, in order to attain a given result.

Planning, considered in this broader meaning of the term, together with administration, comprises nearly all of business management—for administration means carrying out the general plans of an organization in accordance with definite (planned) methods to attain definite (planned) results.

"Plan your work, and work your plan." This well-known dictum is perhaps the tersest statement of the philosophy on which efficient management is based.

Business Management and Business Planning. In previous manuals we saw how important planning is in selling, in sales management, and in advertising.

Not one unquestionably effective move can be made in handling the sales problem of a business without careful planning, without tests and analysis, without constant new planning to meet new conditions. We saw how the sales manager uses his broader knowledge and experience to make plans for the men; how much men as well as management profit thru well-planned sales methods and thru detailed supervision of selling activities.

As we study later manuals in this training service, the importance of planning will again and again force itself to our attention. In financing a business, we shall see that "a debt planned for is half met." We shall see that a plan which determines the credit limits will make the credit man's work more effective. We shall see that office management gains in efficiency in proportion to the care and skill exercised in planning office routines. Not only office routines must be planned, but also office forms must be planned; office layout must be planned; the correspondence and, in fact, each letter must be planned; the accounts must be planned; in short—

> **Every business procedure and action must be carefully planned in advance if it is to fit smoothly into the work of carrying out the general policies and aims of the organization.**

Three basic results of comprehensive planning are as follows:

1. Sound general policies.
2. High standards.
3. Smooth and effective co-ordination of effort.

Planning and the General Policies. The general policies of a business embrace plans which are broad in scope. A multitude of lesser plans are based on the broad plans that are made in applying the general policies.

A book publisher's selling policy may be to sell all his books by mail. With this sales policy established, his financial plans, his employment plans, and his office plans are all shaped to facilitate successful application of the sales policy.

His financial plans, his production plans, and some of his lesser plans, as they demonstrate their value, are gradually crystallized into a definite financial policy, a definite production policy, etc. It is a fact of considerable importance that—

> **Few business policies come into being full blown, but rather grow from careful plans which have stood the test of time.**

Planning and Standards. No man can plan intelligently without knowing the facts on which effective plans are based. A successful bridge builder does not base his plans on speculations regarding the strength of steel, but he knows the relative strength of various kinds of steel. He specifies a particular kind of steel that has been carefully tested. It must be up to a definite standard of quality.

Standards come into being largely because some planner requires them. Planning implies responsibility for the development of standards. It is necessary to remember that—

> **A plan is only an experiment until it has been tried out successfully.**

The planner needs some measure by which the success of his plans can be gauged. Systematic and complete investigation (scientific research) gives the planner a result which he can set up as a standard. Painstaking research, required in careful planning, will often reveal a standard as a by-product, as when time and motion studies serve to set up standards of performance. In planning methods by which labor time can be reduced, research sets up a standard time—an accurately deter-

Standardization As an Aid in Control

Standardization of work defines responsibilities.

Standardization of methods makes the best technique available to all.

Standardization of materials simplifies stock keeping, aids in manufacture, and insures quality.

Standardization eliminates the necessity for a multitude of minor decisions.

Standardization may be applied with much benefit in the following ways:

I. STANDARDIZATION IN THE ADMINISTRATIVE DIVISION

1. General organization charts define responsibility.
2. Departmental organization charts assign the men their tasks.
3. The duties of each position, together with daily, weekly, and monthly routine should be definitely described.
4. Indexed procedures should give in a concise and complete manner the standard policies and standard methods of work for each department.
5. A set of all printed forms should be compiled and indexed with instructions as to their purpose, use, and final disposition.
6. All the impersonal book accounts should be described, showing how to close and reopen each, and explaining the controlling and subsidiary accounts.
7. All reports to executives and to directors and stockholders should be listed and described.

II. STANDARDIZATION IN THE PRODUCTION DIVISION

1. The organization of this division should be defined as to:
    - (a) Types of control and extent of responsibility.
    - (b) Forms and systems for planning, scheduling, and recording times, costs, and inventories.
2. The product should be standardized as to:
    - (a) Numbers and design of models or styles.
    - (b) Yearly and monthly production programs.
    - (c) Method of minimizing seasonal fluctuations.
3. Materials should be standardized as to:
    - (a) Best materials for the various purposes.
    - (b) Manufacture or purchase of component parts.
    - (c) Specifications, including manufacturing limits, allowances, design, inspection.
4. Equipment should be standardized as to:
    - (a) Selection of the types which assure efficient production with a minimum investment.

Figure 1. When anything is to be done repeatedly, there is great advantage in standardizing the procedure that should be followed.

- (b) Layout.
- (c) Standard attachments, tools, jigs, and supplies.
- (d) Capacity for work.
- (e) Inspection and maintenance methods.

5. Operations should be standardized by:
   - (a) The determination of the most efficient series of operations for each job.
   - (b) The determination of standard methods and times for each operation.
   - (c) A standard policy regarding variable factors.
6. Costs should be standardized by:
   - (a) Adoption of standardized cost procedures.
   - (b) Comparison of costs on current operations with past costs.
   - (c) Comparison of costs on current operations with costs obtained thru scientific time study.
7. Working conditions should be standardized as to:
   - (a) The requirements for each process.
   - (b) Sanitation, ventilation, and light.
   - (c) Facilities for employment and personnel work, and the extent to which it is to be carried on.
8. The personnel should be standardized by selecting and keeping the right man for the right job thru the aid of standardized:
   - (a) Job analysis, job classification, and job specification.
   - (b) Employment methods.
   - (c) Training and promotion.
   - (d) Compensation policy and plans.

III. STANDARDIZATION IN THE SALES DIVISION

1. The organization should be charted and defined, and territories, etc., exactly described.
2. Selling prices and terms should be standardized and a minimum of deviation permitted.
3. The extent of maintenance and repair service, advertising and dealer-help service, and all other kinds of service should be standardized.
4. A fixed policy regarding guaranty of product and service should be followed.
5. A standard method of sales presentation should be worked out and taught to the salesmen.
6. The compensation of salesmen and agents should be standardized, and standards set up for expense allowances.
7. Procedures in dealing with prospects, customers, and salesmen should follow standardized policies.

The above list suggests business activities that can well be standardized.

mined rate of work—by which the efficiency of the workers can be measured.

Standard Plans. Thoroly tested and approved plans of procedure, or of method, themselves become standard plans, which may safely be used as a basis for future procedure.

Standard plans or procedures, carefully defined, are of great value in business management. We saw the value of the standard sales talk, when properly employed. We know also that many standardized forms (standard plans for classifying and recording sets of facts and figures) are used in business.

Standard plans can be worked out to advantage for handling a large variety of business activities. Figure 1 gives a list which will prove helpful in suggesting practices that can, with advantage, be standardized in almost every business.

After the standards have been carefully planned they should be written out in detail. This is required by management because—

> **Detailed written descriptions of standard plans and procedures not only make them more available for general use but also tend to clear up misunderstandings and differences in practice.**

Now, having considered some of the broader aspects of planning, let us consider in detail the important problem of production planning, remembering that the essential principles of scientific planning in production apply in other departments as well.

PRODUCTION PLANNING

Production management has, of course, the double function of planning and administration, as has sales management or any other major phase of business management. The planning function of production management is developed to a high point of efficiency in many large industrial establishments.

The works manager and his associates should form a master schedule of work for the year. They should plan to have personnel, plant, and equipment well organized and ready for each requirement. They should plan general works policies regarding employment, hours, wages, and the like.

Modern production management has carefully planned controls by which it keeps in touch with, supervises, and directs shop conditions and shop activities, such as its control of materials, its control of the workmen, and its control thru a cost system. Planning has also within the last few years become an important feature of control.

Control thru Planning. The pioneers in the application of scientific management found that even with the controls mentioned above, and even with production in charge of thoughtful executives whose broad shop policies were excellent, yet many shops, and particularly those where the work was varied and complex, showed poor efficiency when judged by the attainable standards which research had set up. Leaks and losses were analyzed into the kinds of inefficiency shown in Figure 2. All these kinds of inefficiency were in many cases the result of poorly planned and poorly co-ordinated efforts on the part of well-meaning superintendents, foremen, and men.

And this is not to be wondered at, for the processes of industry have become exceedingly complex. In many cases no one man can know of all the elements that enter into the most efficient plan for his own work, let alone for the work of several men. Furthermore, most men are doers rather than planners. Many foremen who are expert in handling their work, and whose departments hum with real activity, lack ability to determine accurately what work is urgent and what can wait if necessary; and they lack the foresight to provide each man

Scientific Planning Serves to Avoid the Following Kinds of Inefficiency:

1. Delays and idle-equipment hours:
    - Waiting for work.
    - Waiting for material.
    - Waiting for tools.
    - Waiting for instructions.
    - Breakdowns.
    - Congestion in certain quarters.
    - Poor dispatching.
2. Machine inefficiency:
    - Wrong speeds and feeds.
    - Ill-adapted machines or tools.
    - Idle machines.
    - Poorly sharpened or tempered tools.
3. Material inefficiency:
    - Materials not standardized.
    - Oversupply of materials.
    - Undersupply of materials.
    - Delayed shipments.
    - Wrong specifications.
    - Rejections.
4. Labor inefficiency:
    - Lack of proper instructions.
    - Doing work ill adapted to the man.
    - Poor physical conditions and light.
    - Soldiering.
    - Lost motions.

Figure 2. Some common causes of production losses. All may be avoided by scientific planning.

well in advance with all the materials and tools he needs for each job.

It became evident, therefore, that if many of the leaks and losses were to be stopped, management would have to take over the responsibility for detailed planning and provide the men with carefully planned procedures to follow and with facilities for carrying them out; also set up standards by which to gauge how well the detailed plans were being carried out by the men.

The Planning Department. To do the planning of work for the men required the placing of the planning function in the hands of well-qualified men who specialized in this one function. This naturally resulted in establishing what are usually called planning departments.

Thru this department, management gains a new control over production. By control thru planning, management not only supervises and directs the detailed methods followed thruout the shop, the order of work, and the like, but also is kept in constant touch with the progress of all work thru the shop as planned.

Let us get a clear understanding of the work in a planning department and see how the control just mentioned is made effective.

For the purpose of making the extent of this control clearer, we shall consider the functions of a planning department in a large plant. But we shall study the purpose back of each activity, so that we may see how the same results may be obtained in a small shop where the "planning department" may consist of one man, and also in an office where the planning function may perhaps take up but a small part of the chief clerk's time.

Questions Answered in the Planning Department. The planning of production answers the following questions in advance of the start of actual work on a job:

1. What work is to be done?
2. What materials are required?
3. Where is the work to be done?
4. How is the work to be done?
5. How long will the work take and when is it to be done?

It is apparent that when all these questions are answered in advance for the shop superintendent and the shop foremen, they are then free to give their entire attention to their men, directing them in doing the work as planned.

THE PLANNING DEPARTMENT

As Designed by F. W. Taylor

The four leading functional divisions:

1. Planning of and supervision over order of work and routing.
2. Planning of and supervision over instruction cards.
3. Planning of and supervision over times and costs.
4. Discipline.

Following are the main activities of the planning department:

1. The complete analysis of all orders taken by the company.
2. Time study for all work done by hand thruout the works, including that done in setting the work in machines, and all bench and vise work, transportation, etc.
3. Time study for all operations done by the various machines.
4. Supervision over all materials, raw materials, stores, and finished parts, and the remainder of the work ahead for each class of machines and workmen.
5. The analysis of all inquiries for new work received in the sales department, including the promising of the time of delivery.
6. Cost of all items manufactured, with complete expense analysis and complete monthly comparative cost and expense exhibits.
7. The pay-roll department.
8. The mnemonic-symbol system for identification of parts and for charges.
9. Information bureau.
10. Setting up and systematizing standards.
11. Messenger system and post-office delivery.
12. Employment bureau.
13. The shop disciplinarian.
14. A mutual accident-insurance association.
15. A rush-order department.
16. Planning improvements in system or plant.

Figure 3. This chart shows a high degree of functionalization. It has great value in suggesting functions that are often overlooked.

Obviously, the planning must be done correctly by those who specialize on this function in the planning department. The five questions above asked are not easy to answer. There must be careful organization of the planning department.

ACTIVITIES OF A MODERN PLANNING DEPARTMENT

The planning organizations which were used by some of the pioneers in developing this control of production were very elaborate. The Taylor planning department, which is outlined in Figure 3, included most of the functional activities of industry, as well as the strictly planning work. Such an organization is impractical in any but the largest plants.

The tendency to-day is to recognize the need of control thru planning and the value of the functions that a planning department can perform; but it is no longer deemed necessary to have a separate individual supervise each function. All the functional activities of planning are recognized, but they are put into practice by training men to handle them all rather than by splitting up the supervision and giving each supervisor authority to issue autocratic instructions.

A typical modern planning organization in an industrial establishment takes charge of the following activities:

1. *Planning the Work and Issuing Production Orders.* This step includes the analysis of the work to be done; securing the designs, where this is necessary; the preparation of specifications as to materials, operations, and tools; the writing of all necessary orders, work tickets, material tickets, instruction cards, tool lists, bills of material, and all other paper work.
2. *Routing.* Designating in what department and with what equipment the various operations on each order are to be performed.
3. *Preparation.* Getting everything ready—seeing that all drawings, materials, tools, fixtures, etc., are at hand or will be at hand when needed.

4. *Scheduling.* Determining how long the work will take and when it is to be done.
5. *Dispatching.* Issuing orders to the various departments to perform the work at such times as will complete it at the time scheduled, and adapting the actual production to a compromise of schedules and interferences, and also uncovering and removing the interferences.
6. *Following up, or recording, or check-up.* This includes collecting, checking, and turning in all time tickets, material tickets, etc., and passing them on to pay-roll, stores, cost, and other departments for accounting. (Technically, check-up includes also all necessary inspection, but usually inspection is handled as a separate function.)

Planning the Work to Be Done. Production orders designating what is wanted and when it is wanted come to the planning department from the sales department when goods are made up on customer's order, and from the general manager's office when goods are to be made for stock.

Orders to manufacture standard parts for stock may be started by the stores keeper, but these orders also, as a rule, go to the planning department head for his approval, since from his contact with the sales department and designing department he will be in a position to know what items are likely to become obsolete and what items will probably be in strong demand.

In a large shop, a "methods engineer" will then plan how the work is to be done, will supervise the work of the time-study and instruction-card man or men, and will collaborate with the man in charge of routing in planning each step of each operation.

Planning Where the Work Is to Be Done. Designating where the work is to be done is the routing function. The man in charge of this work needs to know all about the equipment and the processes of the plant. In a large plant he will have models and drawings of the plant which show the location of equipment; and he will use process maps, explained in Executive Manual 35.

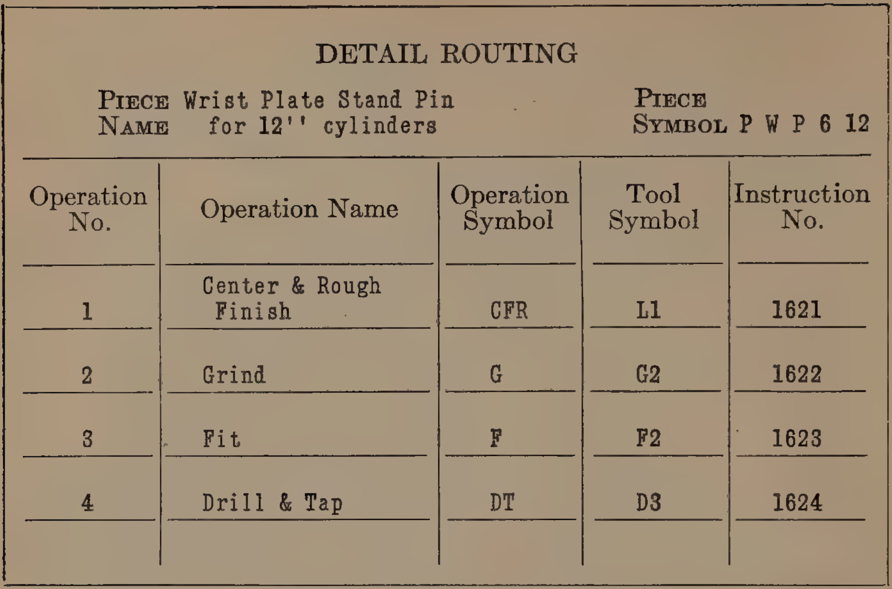
He plans what shop or department and what machine or group of similar machines will have to be used on each operation. He issues standard route sheets for standard products and prepares new route sheets for new pieces, groups, or products.

The route sheets can be put on card indexes for general reference, and they can also be shown to advantage in the lower right-hand corner of detail drawings which are blue-printed for shop use. One route sheet was shown in Figure 4 of Executive Manual 35, while Figure 4 in this manual shows another detail route sheet.

Notice that this route sheet gives first the complete name of the piece, and, second, the mnemonic symbol which is the abbreviation by which the piece is designated on work and material orders. Then follow the operations listed in the order in which the work goes from one man to the next, each operation being designated by an abbreviation or mnenomic symbol. The tool symbol indicates the machine, vise, or space to which the piece is routed. The last column gives the instruction-card number for the operation.

The instruction card was shown in Figure 14 of Executive Manual 35 and is a detailed explanation of the operation. For each operation there may be from twenty to a hundred distinct motion and time elements which are listed on the instruction card. The extent of detail on instruction cards varies with the nature of the operation.

Issuing Orders to the Shop. An order clerk writes up all the orders necessary to route every part thru all the departments which are to work on it. He prepares material lists, withdrawal orders, tool orders, and the like. Either he or the stores keeper starts a requisition for accessories which are not kept in stock and which must be obtained from outside.



DETAIL ROUTING

Piece Name Wrist Plate Stand Pin for 12'' cylinders

Piece Symbol P W P 6 12

Operation No.	Operation Name	Operation Symbol	Tool Symbol	Instruction No.
1	Center & Rough Finish	CFR	L1	1621
2	Grind	G	G2	1622
3	Fit	F	F2	1623
4	Drill & Tap	DT	D3	1624

Figure 4. A detail route card.

In short, the order clerk does practically all the writing that is to be done to put the job thru the shop operations.

Preparation. As soon as the first order papers are prepared, the time-study and instruction-card department consults its records to see whether or not time studies and instructions are available for every item. If not already available for any item on which they are deemed necessary, time studies are made and detailed instructions are written up for that item. In Executive Manual 35 we studied the principles and methods of time and motion studies and saw their relation to instruction cards and labor efficiency.

In Executive Manual 36, where we studied control of materials, we saw how important it is to prepare well in advance to keep the shop supplied with all needed materials. With the same care the planning department foresees the need of special tools, special drawings, and the like, to avoid delays after work once gets under way. The tool lists are checked against the stock of tools, the drawings are checked over, and necessary copies (blue-prints) are prepared. Nothing is left to be done in a last-minute rush, with a group of workmen standing idle.

> **The planning department not only plans just how each order is to be handled and issues all necessary instructions, but also makes preparations in advance so that these instructions may be followed without delay.**

Production Orders and Preparation in the Small Shop. The planning department system, as explained in preceding pages, appears to be complicated. But the essential elements of the system can be adapted for use in any small or medium-sized plant or business.

In a small factory, one man, working in close touch with a superintendent who knows all the technical details of the work, can easily take care of the planning function. As he writes up the customers' orders, he also writes up the shop orders. A bill of materials is prepared in detail from specifications supplied by the customers or by the designing department, and is constantly kept up to date. It is then a simple matter to have the bill of materials copied and checked by the stores keeper or stores clerk, who returns a copy with requisitions for all needed goods which are not in stock. Withdrawal orders are readily made out.

On each detail blue print a route sheet may be shown, and a general route sheet may be shown on the subassembly and final assembly prints.

When a tool list is necessary, it is prepared when the design is made and can easily be copied, checked by the tool-room stores keeper, and used as a basis for tool-withdrawal orders.

A time-study and rate clerk, should there be one, can check the detail blue prints to make sure that instructions and standard times are ready for all operations that require them.

Thus one man with planning ability, perhaps using only part of his time, can, by co-operating with his associates, carry out all the functions of planning which we have studied thus far.

SCHEDULING THE WORK

Of the five questions which must be answered in planning production, the last one listed on page 11—"How long will the work take and when is it to be done?"—is very important, especially where prompt deliveries of finished product to customers are a vital factor of success in the sales department.

> **A company which can deliver goods promptly will very often get a premium for prompt delivery; and a reputation for keeping delivery promises is a very important selling advantage.**

Within the organization, also, the question of time is most important. Many workers are paid, in general, so much a week or month. Salaries, overhead charges, and the like all go on just the same whether the work proceeds quickly or slowly. A simple but very important principle of profitable management is the fact that—

> **The more work each worker can do in a given time, the less will each unit of work cost.**

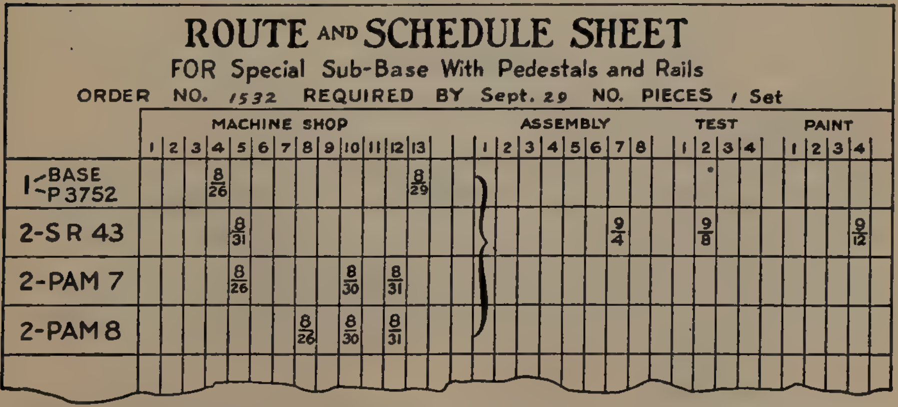
To plan so that each worker may work without interruption is, therefore, one of the prime responsibilities of management. To do this it is necessary, not only to plan ahead so that each machine and worker may be kept busy, but also to plan the order of the work. Otherwise, work will pile up at one point only to slow down other work.

> **So to adjust the order of work in each department as to have work ready for the next operation on time and yet not too much ahead of time, requires a skillful balancing of production schedules.**

That kind of co-ordinated effort is one of the profitable results of comprehensive planning. The responsibility for this scheduling and for the carrying out of the schedule falls on an executive who is sometimes called a dispatcher, sometimes a scheduler; but whatever he is called, his responsibility is always the same.

Planning When Work Will Be Completed. The scheduler finds out from the sales department when deliveries are wanted, and the sales department consults with the scheduler as to dates on which deliveries can be guaranteed. The scheduler can in many cases determine time requirements for completing an order from his own records of time taken to do similar work in the past—not only the actual working time spent on the operations but also the total time which elapsed between beginning the work and finishing it. From the records in his own department he also has positive knowledge as to the work ahead of each department and machine. This information is often kept on a card or sheet for each machine. A rack or scheduling board (described later) which shows the hours of work ahead for each production center, is often used.

By studying what work is ahead, a definite date is determined on which each individual part of an order will leave each machine or production center. These dates are then posted on a route-and-schedule sheet,



ROUTE AND SCHEDULE SHEET

FOR Special Sub-Base With Pedestals and Rails

ORDER NO. 1532 REQUIRED BY Sept. 29 NO. PIECES 1 Set

	MACHINE SHOP															ASSEMBLY									TEST					PAINT				
	1	2	3	4	5	6	7	8	9	10	11	12	13			1	2	3	4	5	6	7	8		1	2	3	4		1	2	3	4	
1 BASE P 3752				8/26									8/29																					
2-S R 43					8/31																	9/4				9/8							9/12	
2-PAM 7					8/26					8/30		8/31																						
2-PAM 8								8/26		8/30		8/31																						

Figure 5. On the route-and-schedule sheet above, the vertical columns show the machines which are to be used on the various pieces, and the dates show the days when each job is to be completed.

such as that shown in Figure 5. A route-and-schedule sheet is prepared for each group of parts or completely assembled machines, or other products.

At the left-hand side of the form shown in Figure 5 is a column for inserting the symbols of the various pieces which go to make up the group. To the right of this are a large number of columns, one for each separate machine, vise, and production space, grouped by departments. All these columns are not shown in Figure 5. But it is apparent that in a shop having a large number of machines, this form may have to be very wide or it may be composed of several sheets fastened together. The date at which each piece is expected to leave each production point is indicated in the proper column.

In this case (Figure 5), several castings are to be machined and then assembled with a motor which is already in stock, and the whole assembly is then ready to be tested and painted. The sheet shows when each operation on the separate parts is to be completed, and also on what dates the assembled group is to be ready to be turned over for later operations.

As each operation is completed in the shop, the work ticket which the order clerk sent out is time stamped and returned to the planning department. The time of completion is then checked against the scheduled time and delays are at once investigated.

Dispatch Boards. The scheduler must see that each job is begun on each machine in the order which his department has planned. He is often assisted in this by using boards variously called assignment boards, dispatch boards, schedule boards, or control boards. Some shops provide each department with a board like that shown in Figure 6.

This board has a series of three hooks for each machine or production point in the department. The

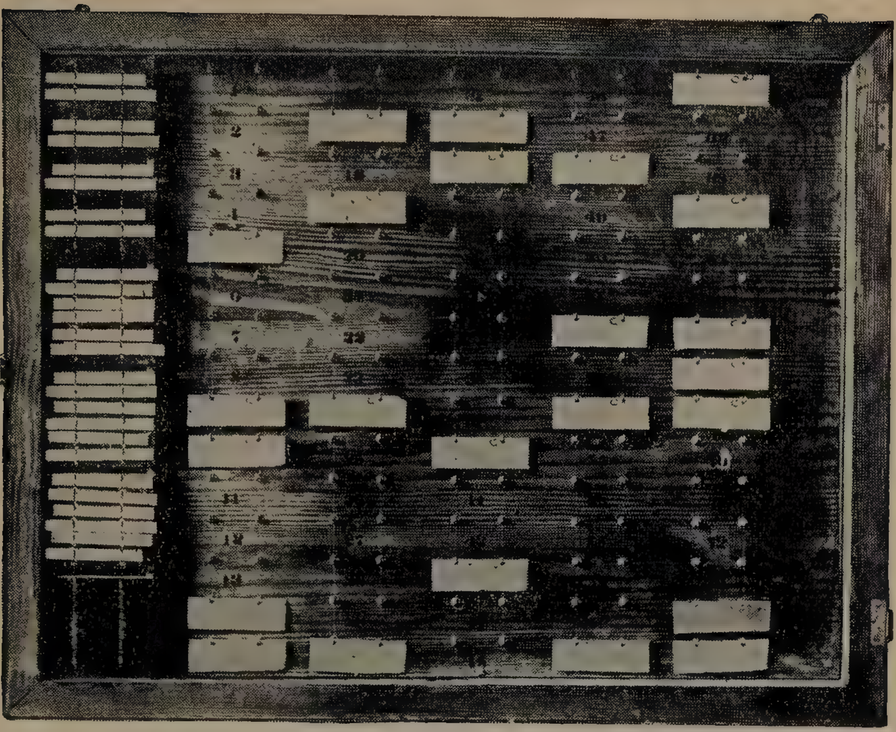


Figure 6. A departmental schedule board. Three sets of hooks are provided for each machine in the department.

upper hook has hanging on it a ticket designating the job on which the man is working. The next hook holds tickets on the jobs ahead for which the material is ready, arranged in the order in which the jobs are to be done. The third hook has jobs which are to be worked at in the future, but which are not as yet at the machine. This type of board is usually called a "dispatch board." Figure 7 shows another type of dispatch board in frequent use, in which pockets are used instead of hooks. These pockets often hold all the instruction cards, blue prints, etc., that go with each job.

In some shops a master board, which duplicates all the "local" dispatch boards of the shop, is to be found in the central office of the planning department, and duplicate tickets are hung on it.

As work is completed in the shop, the ticket for that work is removed from the departmental dispatch board,

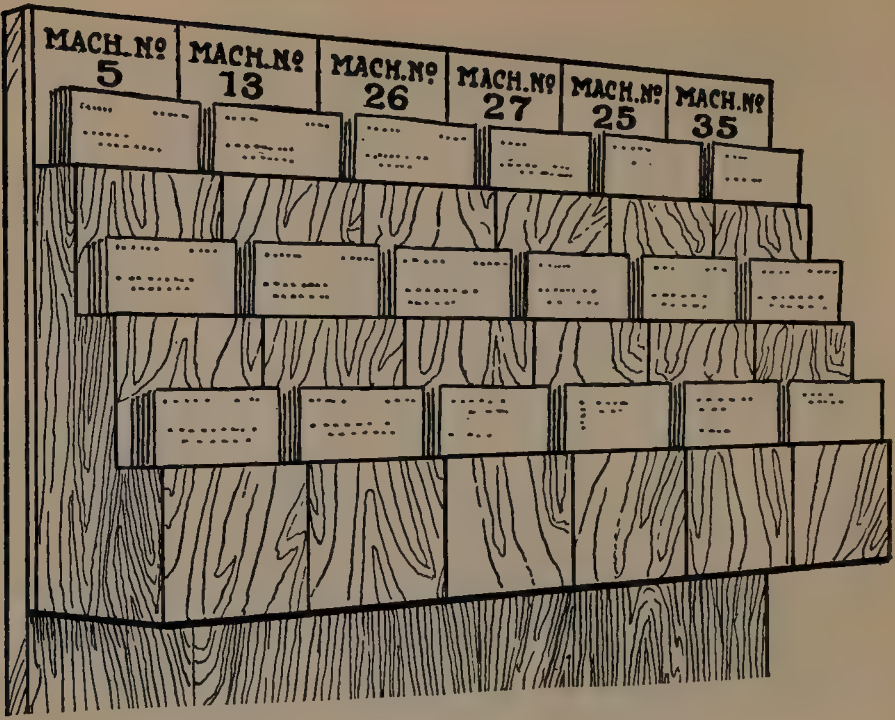


Figure 7. Another type of dispatch board.

by the gang boss or time clerk, and is sent to the planning department, where the correctness of the procedure is verified by comparison with the order of work and the dates on the master dispatch board tickets.

Control Boards. Various devices for giving a complete picture of the entire production situation are used. These are generally called control boards. They are large boards, about the size of a schoolroom blackboard, with slots or grooves thru which strips made of metal or wood or cardboard can slide. On these strips are written the order numbers, symbols, and other condensed information.

The board is usually marked off into vertical columns representing days, and each horizontal groove represents a machine, or production center. The sliding strips are of different lengths; they are placed in accordance with the schedules, and are readjusted from day to day in accordance with progress on the work.

A central control board which is easily accessible to the works manager and others responsible for planning, scheduling, and dispatching may be of great help if intelligently used. It is not a substitute for brains. A central control board helps the executive to see the entire production situation clearly and quickly; but planning the moves on the board calls for intelligence, ingenuity, and imagination—something no board will ever have!

How Control Boards Are Used. The way these boards are used can best be explained by reference to the very simple control board illustrated in Figure 8. On the left-hand side are the numbers of all the machines and workmen's bench positions, grouped by departments. To their right are a large number of vertical columns, each representing a day and each, say, one inch wide. (In that case one-eighth inch will represent one hour in an eight-hour working day.) If work is to be scheduled some three months in advance, about one hundred columns will be needed.

The columns may be divided into groups of six, each representing a day of the week. At the head of these columns the working days of the week are usually painted and above them a strip is painted black to be used as a blackboard on which the corresponding days of the month are written.

Pieces are then cut from strips of heavy cardboard or wood which slide in the horizontal grooves. If an eight-hour day is represented by a one-inch column, the length of the strip will be one-eighth of an inch for each hour of the machine time required, plus whatever time will be needed to set up the machine for the new job. On the strip is the order number, the number of pieces to be processed, the symbol of the piece, and the date when the operation is scheduled for completion.

Strips of different colors can be used. Stock orders, for example, the work on which can usually be inter-

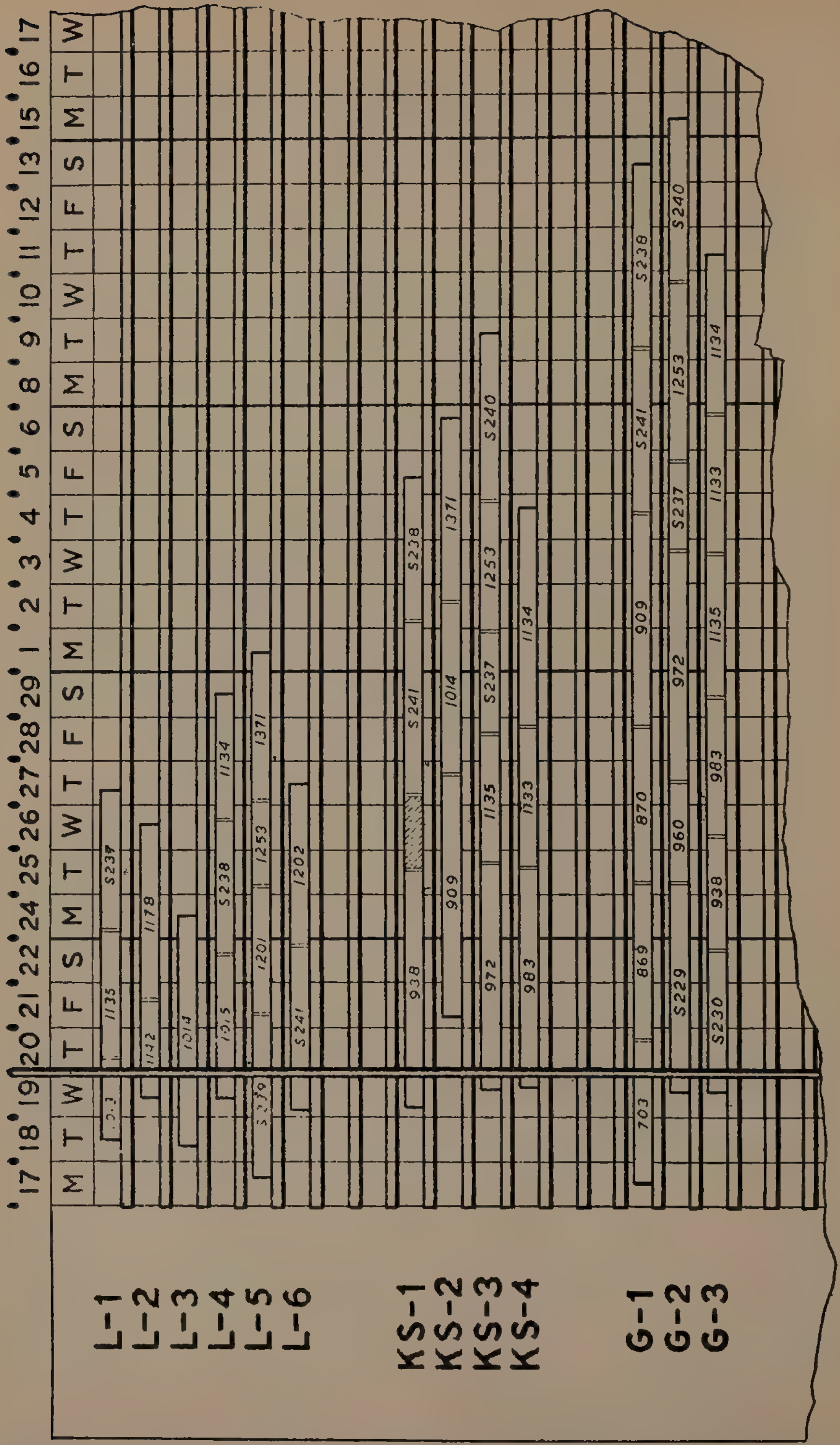


Figure 8. A control board which shows what jobs are going thru the shop and when each job is likely to be completed by each department. The symbols at the left show the machines or bench positions which are to handle each job.

rupted with less serious results, may be shown in a different color from customer's orders. Orders to shut a machine down for complete overhauling may be shown in another color, and so on. Interruptions in schedule due to a holiday can be shown by inserting a blank strip of one day's length.

Figure 8 shows a small section of a board on which the work of six machines of one type, four of another, and three of a third are scheduled. Figure 9 shows the upper left-hand corner of this same board enlarged to give a better picture of the detail.

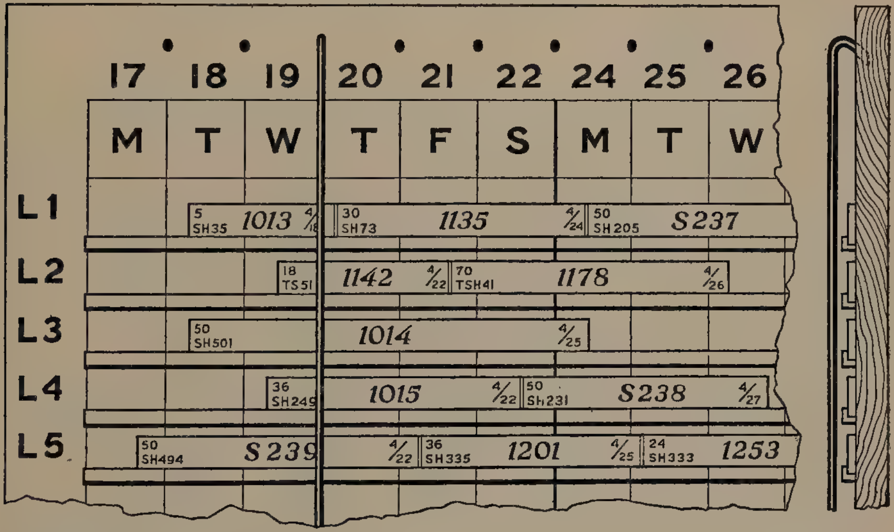


Figure 9. The upper left-hand corner of the control board shown in Figure 8.

The vertical line between 19 and 20 is a rod which shows that the current day is Thursday, the 20th. The job now on machine L-1 is order 1013, which is behind schedule, since it was to be completed on the 18th. This is shown by the notation on the strip.

At about 10 o'clock on this day L-1 is to begin work on Order 1135, which is to be completed on the 24th. Machine KS-3 is to start work on the same order on the 25th and complete it on the 28th. The work then goes to machine G-3, which starts work on the 29th and completes it on the 3d of the next month. This is evidently a rather urgent order, for it is put ahead of other orders.

Order 938 is also being rushed. On the 20th it is started on KS-1, and work there will not be completed until the 25th. The pieces completed during the first two days, however, will be taken to machine G-3 on the 22d, and that machine will complete its processing on the 26th. Note that KS-1 is to be shut down fifteen hours for overhauling, as soon as order 938 is complete, and is then to proceed with two standard-part stock orders.

It is evident that with such a picture of the status of the work ahead of every machine, the dispatcher can not only see at a glance how work is progressing, but he will move the sliders along if any job is delayed and then shift jobs if this is necessary and possible. Suppose, for example, that machine L-6 breaks down while working on order S241. Order 1202 may be shifted to machine L-3, perhaps, since that machine has nothing scheduled after order 1014 is finished.

Adaptations of the Control-Board Idea. The control-board idea is adaptable not only to the routing of shop work but also to the routing of once-in-a-while jobs in an office. A group of clerks may have routine work which keeps them busy an average of five hours in each seven-hour day. The control board will then cover the other two hours alone; that is, each column will represent two hours. Jobs can be planned ahead for these two hours, so that monthly or quarterly rush periods may be anticipated and eliminated as far as possible. In large organizations, the departments may be shown on a master board and the separate machines and bench work indicated on departmental control boards such as have just been described.

Control boards are also worked out which show the standing of each order. Some of these boards are very elaborate. The design of every practical board, however, is based on the principle that—

> **Periods of time and the relations between them can be understood and controlled better when graphically represented by lengths and relative positions of lines.**

By periods of time here is meant any duration of time, whether measured in years, weeks, hours, or minutes.

With a complete and clear picture of his facts before him, the man in charge of scheduling and dispatching is better able to plan the work for each department so that it will be done promptly and efficiently; also a check-up on the progress of the work is facilitated.

CHECKING AND FOLLOWING UP THE WORK

An important factor of control thru planning is the check-up, thru which an executive follows up the progress of the work in the shop.

In Executive Manual 36, we saw how material lists and material withdrawal orders are used to control the use of materials. When these papers have served their purpose in shop and storeroom, they are returned to the planning department, and to the cost department, since these lists and withdrawal orders are used in control thru cost, a subject which is opened up in Part II of this manual.

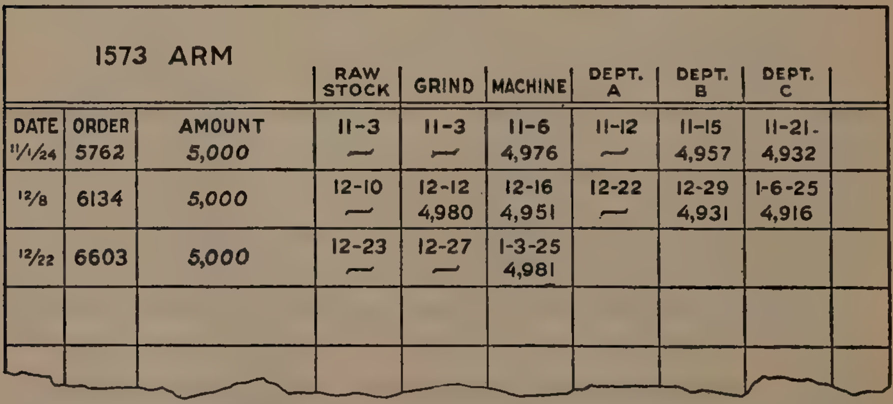
But before the records reach the cost department for final sorting, posting, accounting, and statistical use, most of them, and particularly the job tickets and material tickets, serve a useful purpose in expediting the check-up and follow-up of the work in process. The forms of these tickets are therefore an important matter to the production manager, as well as to the accountant and stores manager.

The forms should be prepared and standardized to include a record of all facts required by all those who use them in various ways. Also a standard routine must be planned which describes the path of each ticket and its uses.

A loose-leaf binder, on the pages of which are mounted samples of each of the printed forms used in connection with production, is a useful guide for the works manager, the production manager, and the cost accountant. Below each form it is advisable to have a typewritten statement of its purpose, its origin, its route, and its final disposition.

Tracing Delays and Interferences. The date of completion of each job is stamped on the department job order or ticket and this information is checked up against the dates shown on the route-and-schedule sheet (Figure 5), on the master dispatch board (Figure 6), and on the control board (Figure 8). The details of this routine will not be described, because it is different in almost all organizations.

In organizations where the work does not require detailed production planning and scheduling, the progress of orders thru the shop is often traced on a card like that shown in Figure 10. This form is particularly useful where stock orders or customers' orders for standard goods go thru the shop repeatedly. It is the usual prac-



1573 ARM			RAW STOCK	GRIND	MACHINE	DEPT. A	DEPT. B	DEPT. C	
DATE 11/1/24	ORDER 5762	AMOUNT 5,000	11-3 —	11-3 —	11-6 4,976	11-12 —	11-15 4,957	11-21 4,932	
12/8	6134	5,000	12-10 —	12-12 4,980	12-16 4,951	12-22 —	12-29 4,931	1-6-25 4,916	
12/22	6603	5,000	12-23 —	12-27 —	1-3-25 4,981				

Figure 10. A tracer card showing the date on which work on an order is completed in each department and also the number of perfect parts turned over to the next department.

tice not only to show the date at which the goods leave each department but also to show the number of items. This record will thus show what proportion of goods was spoiled on previous orders and give a basis for comparison and checking. Such records are valuable, because they point out the places where it is possible to effect new economies, altho some spoilage, of course, probably cannot be avoided.

When any process is not completed on the day set, the progress of the work may be traced by a supervisor, or tracer, whose duty it is to remove the cause of delay if possible and bring progress up to schedule again. Some organizations designate this process as "removal of interferences" and call the supervisor an "interference man" instead of a "tracer." Others use the term "dispatcher."

A device which is sometimes used to follow up the movement of work from operation to operation, from group to group, or from department to department, is the telautograph. The movements are recorded by pencil memoranda written at the various stations by department foremen or production men covering the field surrounding that station. At one or more central recording stations, the automatic electrically operated pencil (the telautograph) instantly records the message in the exact handwriting of the original. From these records on rolls of paper at the central station the movements thruout the shop are posted on master order cards or sheets.

It is evident that whatever the system of follow-up, recording, or check-up may be, the certainty of successful control depends largely on the care with which these records are posted and the forward-looking study which they receive.

It is far easier to avoid delays by means of shifts in planning when trouble first develops, than to make up for lost time later on.

QUESTIONING THE EFFICIENCY OF PLANNING

In concluding our study of scientific planning, let us briefly answer two questions that are often asked concerning the efficiency of planning.

Does Planning Mean Additional Nonproductive Labor? That is the first of these two questions. A superficial examination of planning methods frequently leads owners and managers who are not well acquainted with planning procedure to form the opinion that the use of these methods is accompanied with a very high overhead expense. In actual practice, however, scientific planning has resulted in remarkable increases of output in relation to the number of men and machines.

Under an efficient planning system no new work is introduced into the enterprise. The work of planning under traditional methods of management is done by all classes of foremen and clerks, none of whom specializes in this one important function. Consequently, the planning is not expertly done and it is bound to result in many avoidable wastes. It is apparent, however, that—

> **A scientific planning system applies the principle of specialization to the work of planning, and all the planning is done by men who are best fitted to do it.**

At the plant of the Tabor Manufacturing Company, in Philadelphia, the introduction of a planning department almost doubled the output without any increase in the total number of employes or equipment. There are innumerable cases wherein scientific planning, as an integral part of the scientific management in the shop, has reduced the cost per unit of product from 10 to 100 per cent. There are also many offices, banks, and mercantile establishments where scientific methods, including scientific planning, have resulted in lowering operating expenses to a like extent. How this is done in the office will be explained in detail in a later major section of this training service.

It is important to bear in mind the fact that members of the planning department are, in nearly all cases, not experts brought in from outside, but are the best men already in the organization, who are especially trained for this work. Each of these trained specialists should be designated by a title co-ordinate in rank with a department managership, rather than "clerk" or "boss," as some of the "systems" of scientific management call them. The prestige implied in the higher title is helpful to them, and they work with greater effectiveness and enthusiasm as a result of it.

Does a Planning Department Do Nothing but Plan? That is the second of the two questions that are often asked.

The name "planning department" is somewhat misleading, since planning has to be done by all the officials and department heads.

The work of this department has to do specifically not only with the planning of production but also with the handling of production records and statistical facts which guide the men who are actually engaged in the work of planning ahead. Planning also includes men who see that the production is carried out in accordance with the planning.

In short, this department is responsible for control thru planning. It not only makes plans for production but it supervises the way in which the plans are carried out, it initiates and directs any necessary changes, and it keeps the management constantly in touch with the progress of the work.

It is apparent that this kind of planning, broadly conceived, gives management a valuable control of operations which supplements control of materials.

In Part II of this manual, we begin our analysis of control thru costs. This is another phase of control which gives the executive a valuable process by which his management is made effective.

CONTROL THRU PLANNING

Part II

THE PART THAT COSTS PLAY

AS THE compass and sextant enable a captain to guide his ship safely to port, so an accurate cost system enables the efficient manager to guide his business toward the goal of net profits.

Almost every industrial enterprise has some system of records relating to costs, and it is essential in all executive work to understand and be able to make practical use of cost figures, for they are an indispensable aid in making sound executive decisions of many kinds.

The Need of Accurate Costs. So important are cost figures as an aid in management that competing manufacturers often get together for the purpose of discussing cost accounting; and there are several large manufacturers' cost-accounting associations that meet regularly.

One objective of co-operation in a study of costs among competing manufacturers is to establish a standardized method of figuring costs, which places price competition on a sound basis. Each manufacturer can then figure his costs as the others figure them. If a certain manufacturer enjoys an advantage in efficiency, his costs will be relatively low, and he can quote a low price. But no manufacturer who uses the standardized method of figuring costs will be likely to quote a price that does not cover his costs. A manufacturer, however, who does not know his costs may quote a price that gives him a loss. Mistakes of this kind are injurious to an industry as a whole.

A company that had been building a line of medium-weight steam engines undertook to build very large engines. It was compelled to add powerful machine tools to its equipment in order to build the larger engines. Instead of devising a correct distribution of operating expenses and allotting the proper machine rates and departmental expense rates to the new machines, it added the same expense percentages as had been added on the old line. As a result, the *apparent* cost was so low that this company greatly underbid old established concerns which were building large engines.

WHAT A COST SYSTEM DOES

1. Wastes are made noticeable, so that they may be eliminated.
2. The profitableness of making each item in the line is disclosed.
3. A basis for establishing a fair selling price is provided.
4. A basis for establishing standard unit costs is provided.
5. A basis is provided for comparing costs, and profits, in one period with another, in one department with another, and in one plant or establishment with another.
6. Preparation of financial statements, state and Federal reports, and tax returns require cost figures.
7. Accurate planning and gauging the results of plans are aided by cost data.
8. Facts useful in the establishing of policies and in the control of the execution of these policies are found in cost data.

Figure 11. A chart showing some of the more important advantages gained thru using a well-designed cost system.

The executives of this company were elated over their success in securing a large volume of sales. But at the end of a year, total expenses had run much higher than expected. A higher manufacturing expense was uniformly distributed during the next year. This, however, caused the apparent cost of the lighter engine to be figured so high that it could not be sold at the old prices. Then prices were raised on the lighter product, and, naturally, business was lost. Ultimately, the company failed.

Inaccurate knowledge of costs is one of the common causes of business failure.

Cost accounting merits the close attention of management. There are very important advantages to be gained from scientific cost-accounting methods.

The traditional cost system usually served only two purposes, and they were the least of the ends gained by using a scientific cost system. It gave the billing department some kind of basis for establishing prices on repair parts; it also told the superintendent when a job had apparently cost a great deal more than the same job had cost before. But much more can be expected of a cost system.

THE BENEFITS OF A COST SYSTEM

Other benefits of a cost system are shown in Figure 11. Let us gain a clearer understanding of cost accounting by briefly surveying these eight points.

1. Wastes Are Disclosed. A comparison of the costs of the material and labor that are going into an order with equivalent costs on earlier jobs will at once call attention to excessive items. Furthermore, merely breaking up costs into costs of various operations is likely to reveal apparent inconsistencies to the eye of an experienced executive, suggesting opportunities for improvements.

Accurate comparison of conditions and results at one time with those at another time is often the means of uncovering discrepancies. Then finding the true causes of the discrepancies leads to improvements.

If comparison and scrutiny are supplemented by time and motion studies, which establish standard costs for comparison with current costs, it becomes possible to detect current wastes as they occur, instead of after they have happened. An efficient system of classified standing-expense orders (fully explained in the next manual), if compared month by month, will show fluctuations which, if studied, will reveal ways of avoiding many wastes.

2. Shows Costs of Individual Items and Parts. Knowing unit costs of items and parts, an executive is able to study costs on separate operations. Unless the cost of parts is known, the pricing of repairing and of replacing parts is guesswork.

A company making individual parts in quantity is in position to make a considerable profit on these parts, since they are sold with no competition other than the prices quoted by job shops which have to make the parts singly and consequently at a much greater cost. The manufacturer offers the additional advantage of immediate delivery, because he has the parts in stock. It is thus apparent that—

> **A cost system on assembled products should be designed in such a manner that the costs of individual parts may be easily determined.**

Knowing the unit cost of each kind of product is important, because the relation between costs and selling prices will vary for different items in a line. When the high-cost items are known, the selling plans can often be shaped to sell few of these as compared with the sales on more profitable items, unless a large volume of sales on the high-cost items more than offsets the disadvantage of a small margin of profit per unit sold. This point was covered in our preliminary survey of sales management, in Executive Manual 5.

3. Acts As a Basis in Determining Selling Prices. Accurate cost systems not only disclose items on which the largest profits are possible, but also supply a sound basis for determining minimum prices.

A company cannot long sell below cost, no matter what price competitors are asking. It must get for its products an average price which shows a living profit.

> **If orders cannot be obtained at a price which covers all costs and shows some profit, the sooner the management knows this the better.**

Immediate steps can then be taken to reduce costs; and, as previously pointed out, analysis of costs is a major preliminary step in discovering ways and means of reducing costs.

4. Provides Basis for Standard Unit Costs. Many firms work out standard unit costs from a study of past costs, apart from assurance that past costs were as low as they might have been. But where there is assurance that the standard costs set up are as low as it is possible to make them, as when time and motion studies have been made on the operations, then comparison with standard costs becomes a much better means of control.

In any case management should make sure that the cost of each operation is running uniformly before it uses past costs as a basis for estimating future costs.

5. Provides Valuable Comparisons. Obviously, cost comparisons aid in determining relative efficiencies. Let us here take up one of the many comparisons in costs that can profitably be made.

The studies of the Federal Trade Commission and of the United States Department of Commerce have shown that much price cutting and other unsound trade practices are indulged in largely because the business heads are ignorant of their exact costs. Various trade associations and other trade and research organizations have sought to remedy this and to encourage the use of uniform systems of cost accounting so that exact costs of manufacturing and of selling would be determined, affording opportunity for reliable comparisons.

The Chamber of Commerce of the United States, for example, has issued and widely distributed a series of studies which report and analyze average costs of running retail stores of various kinds and sizes. A merchant who has figured his own costs accurately can compare his costs with the average for stores of his size and kind, and thereby find out where his own costs can probably be reduced; that is, where possible economies can be made in operating his business.

Many trade associations compile such averages from reports of their members, so that each member can compare his costs with average costs as a means of determining where economies may be made. In some associations, members discuss costs with each other in the effort to reach new economies.

6. Assists in Determining Taxes. Probably the income-tax law has done more than anything else to cause the business man to appreciate cost accounting. Cost accounting is necessary in order to determine the exact amount of taxes due. A tax based on net profits makes it necessary to take all costs into consideration.

Furthermore, a company's financial situation is far more definitely known when the cost accountant is able every month to report the exact value of inventories of raw materials, of work in process, and of finished stock.

7. Acts As a Basis for Planning. When there is a choice in methods or in men to do certain work, the relative costs will always be considered; and in many other ways costs are the basis of planning.

Cost accounting records also indicate, as a by-product, the promptness with which material is furnished on specifications, the efficiency of the storeroom management in replenishing depleted stocks, the promptness with which the shop can make special parts, the percentage of spoiled parts, the use of supplies, the accuracy with which the various parts are machined for assembling and erecting purposes, and so on.

Figures on labor costs furnish information as to the productive capacity of various individuals and groups of men; as to the accuracy of the time-keeping department; as to the effects of piece-rate, bonus, premium wage systems on shop costs; and so on. All this will be made clear in Executive Manual 38, where control thru costs is covered in detail.

8. Guides Company Policy. When a manufacturing committee must decide whether or not to increase production by overtime work, data on overtime costs taken from cost-accounting records will probably be considered in order to determine what policy to follow.

When the works manager must decide whether to buy brass castings or to continue to make them, his decision will be based largely upon cost data.

When the directors must pass on abandoning an old plant in favor of a proposed new plant, their decision will be based largely upon a consideration of costs in the old plant as compared with carefully estimated costs in the new plant.

When a sales manager proposes to increase profits by selling more goods at a lower price, and says that the manufacturing overhead charged against each unit of product will fall enough to give larger profits, the cost-accounting records will be analyzed to find out whether or not he is right about it.

Such are a few of the many uses of cost accounting as it enters into important executive decisions. But we should remember that—

> **It is as a control for keeping in touch with the work of all the departments that an appropriate cost system can be of most help.**

Cost-accounting data on manufacturing expense, for example, will show the economy or wastefulness of the various foremen, and will suggest lines of investigation to determine whether or not certain expenses can be reduced. The full extent of this kind of control will become evident when, in the next manual, we take up the uses which a manager can make of the reports which the cost department provides.

CLASSIFICATION OF COSTS

Costs cannot be studied or used intelligently "in the large." They must be studied in detail, properly classified, analyzed, and finally redistributed in groupings which will give the executive a clear grasp of the conditions which these costs reflect.

Let us, as a first step, classify the various elements of cost. What are these cost elements?

The Elements of Cost. Figure 12 lists the fundamental cost elements. Manufacturing costs constitute the first main group. These may be classified as direct costs and factory overhead expense.

The first element in direct costs is material cost. This is the invoice cost of the raw materials, to which is added the "material burden," covering the cost of buying, transporting, receiving, storing, issuing, and recording materials.

As pointed out in Executive Manual 36, the material burden is usually added to the invoice price for the quantity of material received, and the sum is divided by the quantity in order to determine the unit price for cost-finding purposes. If this is not done, these expense items are often included in the total of factory overhead expense.

The next element in direct costs is direct-labor cost, which includes all the labor expended directly upon production orders. It does not include any indirect labor, which is labor that cannot be charged against any particular production order.

The final element that goes to make up direct cost is any additional expense that can be directly charged to some order, as when insurance is taken out on some particular lot of valuable material for a special order.

- TOTAL OPERATING COST
  - MANUFACTURING COST
    - DIRECT COSTS
      - RAW MATERIALS, and MATERIAL BURDEN (including freight, purchasing department, receiving department, and stores expense.)
      - DIRECT LABOR.
      - DIRECT EXPENSE (any Expense chargeable to a specific production order or process).
    - FACTORY OVERHEAD EXPENSE
      - INDIRECT MATERIAL (cost of materials not identified with a specific order, as supplies, waste, small tools).
      - INDIRECT LABOR (labor which cannot be charged directly to a specific order) as:
        - Superintendence, foremanship.
        - Factory-clerks' salaries.
        - Inspection.
        - Experimental work.
        - Other factory labor.
      - INDIRECT EXPENSE (all factory expenses other than material and labor) as:
        - Fixed plant charges:
          - Taxes on land, building, and equipment.
          - Insurance on building and equipment.
          - Depreciation on building and equipment.
        - Variable plant charges:
          - Lighting, heating, and power.
          - Liability insurance.
          - Maintenance and repairs, buildings and equipment.
          - Miscellaneous factory expense.
          - General department expense.
  - COMMERCIAL COST
    - SELLING EXPENSE
      - Sales management.
      - Salesmen's salaries.
      - Salesmen's expense.
      - Branch selling expenses.
      - Advertising.
      - Commissions.
      - Miscellaneous selling expenses (including proration of rent, light, telephone, etc.).
    - ADMINISTRATIVE EXPENSE
      - Officers' salaries.
      - Officers' expense.
      - Clerical expenses and salaries.
      - Legal expense.
      - Auditing.
      - Reserves for bad debts, etc.
      - Telephone and telegraph.
      - Stationery and printing.
      - Miscellaneous general expense (including prorations).

Figure 12. A list of fundamental cost elements grouped to show how each contributes to the total cost of the product.

Factory overhead expense has three classifications or groups. The first group includes indirect material or "expense material," such as cotton waste, machine oil, brooms, and so on. Indirect labor is also included in the second group; it cannot be charged directly to a production order and is therefore charged to an expense order of the "standing-expense order series," fully explained in the next manual. Salaries of bosses, foremen, superintendents, planning department heads, and works manager are also included in factory overhead expense.

The third group of overhead expenses includes all fixed charges, such as depreciation, taxes, and insurance on plant; and all variable plant charges, such as power, lighting, heating, repairs, maintenance, etc.

Such are the manufacturing costs. There remain those operating expenses that are often called "commercial costs." They are divided into selling expenses and administrative expenses, as shown on the chart (Figure 12).

By adding together all the above-mentioned direct and indirect cost elements, we get the total operating cost of manufacturing and selling a company's product and of managing the business. Subtracting this total cost from the total price charged for the goods sold, we get the company's operating profits.

But this is not likely to be the net profit, because the interest on money borrowed, the discounts that have been paid and taken, and extraordinary losses must also be taken into consideration.

Cost As a Basis of Selling Price. A cost price for any article is obtained by adding to the direct costs which enter into its manufacture a proper proportion of all overhead expense. How overhead is apportioned or distributed will be covered in Executive Manual 38.

To get a satisfactory selling price based on the cost price, it is necessary to add to the cost price an amount for profit which will be ample not only to cover dividends and the non-operating costs, such as the net interest paid, but also to provide a margin of safety sufficient to care for additional accidental costs, such as errors in design or construction, defective goods, unusual bad debts, and the like.

The amount of profit to be added to the operating cost is rarely less than 20 per cent of the selling price. Under ordinary circumstances the gross profit or mark-up on repair parts is higher.

Where competition is strong, a gross profit or mark-up somewhat lower than 20 per cent of the selling price may have to be fixed in pricing the finished product.

It is not likely that a concern paying dividends of 7 or 8 per cent will have an exorbitant surplus left when it sells its product at a mark-up over operating cost amounting to 20 per cent of the selling price. Extraordinary expenses and losses of many kinds, as when manufactured goods and parts become unsalable or obsolete, cut down surplus earnings. This applies in both manufacturing and mercantile lines of business.

The Importance of Departmental Cost Analysis. Operation of some departments of a business may be exceptionally efficient, while of others it may be inexcusably weak. Production may be efficient, and selling weak. Selling and production costs may be low, yet administrative costs or financing costs may be so high as to leave no net earnings. Thus it is important to know departmental costs; and it is, therefore, imperative that—

> **The several elements of cost which make up the selling price should be kept separate and distinct so that they may be assembled and studied in various combinations.**

In a merchandising or trading business it is quite customary to determine the costs of buying, handling, storing, and selling the goods for any one department by means of the receipts for that department.

In continuous-process manufacturing types, whether analytic (taking apart) or synthetic (putting together), it is customary to figure the costs of processing per unit of output and to compare these unit costs daily, weekly, and monthly.

In assembling types of industries, such as the building of machinery and furniture, it is usual to figure costs both by departments and by the individual orders. These costs are assembled from costs of detailed parts, some of which have been made in quantity on stock orders and some of which have been made up specially for a given order.

Fitting Costs into the General Accounts. A cost system records hours, amount of materials, and number of men. But cost accounting can convert these time and material units into dollar costs, and its findings are usually stated in dollars.

Time and material, building maintenance, tools, supplies, and the rest cost money. The company pays dollars for them. The cost accountant keeps track of the hours, amounts of materials, power requirements, etc., as they are being used in the shop and office; gives each unit its proper dollar value; classifies these dollar values; and distributes them to the proper accounts.

Thus he accounts for all the money used in the operation of the business, and is able each month not only to tell the chief financial accountant where the money went but also to contribute the following important facts which enter into the making up of the company's monthly balance sheet:

1. Cost value of materials received during a given period.
2. Cost value of raw material and of finished parts in stores.
3. Cost value of work in process in the shop.

4. Cost value of finished goods shipped during a given period.
5. Cost value of finished goods ready for shipment.

The procedure by which the manufacturing costs and expenses are classified and distributed is fully explained in the Appendix on classification and distribution of costs on page 55. You may there see just how this distribution is made monthly in a typical metal-working plant.

Cost Accounting As a Branch of Accounting. The close relations of cost accounting to the work of the shop office, the planning department, and the stores department have led some organizations to consider the cost accountant a member of the works manager's staff. But this is not the usual or the preferred plan, for the cost-accounting system is essentially a branch of the general accounting system.

It is true that much of the cost-accounting work is done in the shop office. The stores clerk, for example, often works under the cost accountant, because the perpetual-inventory records maintained by the stores clerk are essential features of the cost-accounting system.

Cost accounting, however, is accounting work, and as such can best be supervised by a chief accountant who knows cost accounting as well as general financial accounting, rather than by an expert in production. But very close co-operation between the accounting and production forces is needed to get satisfactory results.

All of Executive Manual 38 will be given to this important matter of cost accounting, and especially to a study of the control which it puts into the hands of management. A study of Figure 13 will clarify and simplify your grasp of this important problem.

But you will not be fully prepared to grasp some of the important details of Executive Manual 38 until you shall have handled Executive Problem 37, which will help in developing greater ability to plan work in advance so that production will proceed in the most effective and economical manner. The following check-up on principles will serve to make the handling of Executive Problem 37 simpler and more interesting.

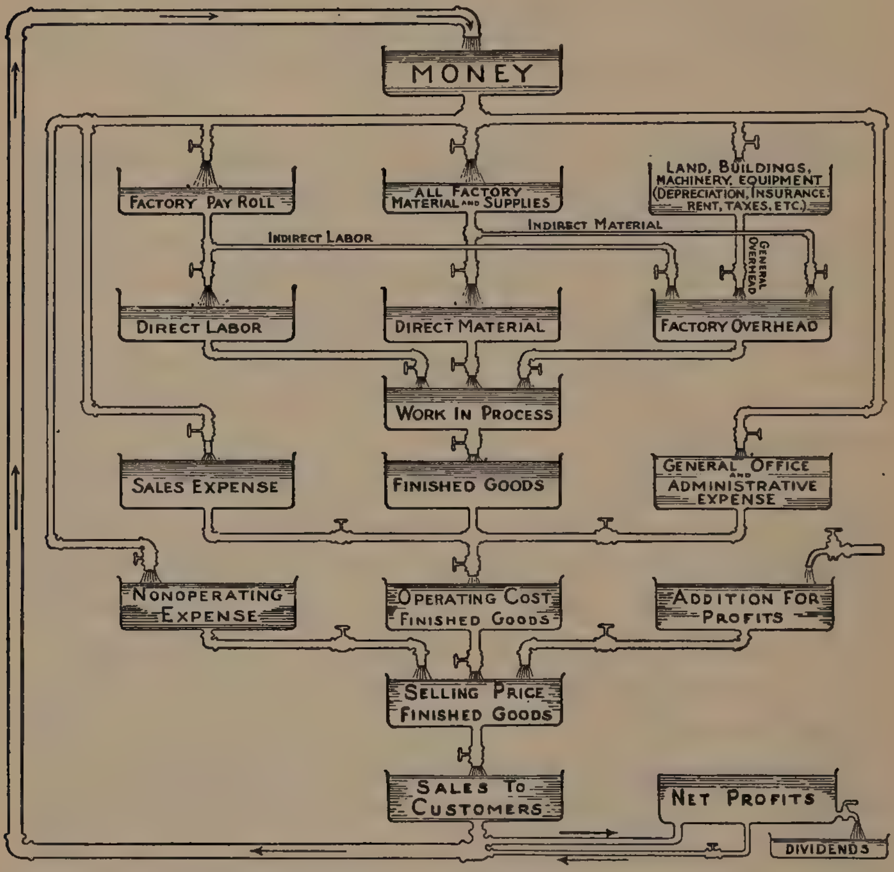


Figure 13. The flow of money and money values in the manufacturing and selling cycle. Note that the reservoir of money at the top is continually being refilled by money that comes in from sales at the bottom; that some of the money from sales flows into the net profit reservoir; that some of net profits goes to pay dividends and some goes back into the business. The flow of money, as absorbed by labor, materials, supplies, equipment, etc., can be studied as graphically charted above, for the increased understanding it gives on the problem of control thru costs.

CHECK-UP ON PRINCIPLES

Use the following check-up to get the principles of this manual firmly fixed in mind. This will help you to handle the problem which follows. This check-up is entirely for your own personal use, so you need not send it in to the University.

	Check	
	Yes	No
At the peak of a boom period, the Sigsby Company did its utmost to keep pace with orders. Some orders would get out on time, others, weeks late. The average delay was three weeks. The Bigby Company was in even a worse plight, with an average delay of four weeks. The Bigby orders were carefully scheduled, however, and went out in turn. Is the trade likely on that account to be more lenient with the Bigby Company than with the Sigsby Company?		
One of the most popular of the "$1,500 class" autos can in most years be sold in greater numbers than the management considers it prudent to make. Is this caution an evidence of careful planning?		
An extensive chain of grocery stores requires that each new location must completely meet certain very definite standards, among which is a high proportion of "laborers and mechanics" in the locality. If an unusually good opportunity presented itself to get into a "salaried man's" neighborhood, would it not be wise to do so?		
A was an advertising man whose hobby was pomology—the science of apples. He developed a new variety of the apple tree, which he determined to market himself. As a sales-research test, he sold in one state thru direct-by-mail advertising; in another, thru house-to-house canvassers who handled trees as a side line; in another, thru ads in the state horticultural journal. His biggest sales, however, were personal sales, made almost accidentally, to the fellow exhibitors in the state apple show. One salesman now attends these shows and markets all the trees. Can this be called a carefully planned sales policy?		
In a certain organization customers' orders had to be routed thru the credit department and also thru the sales department. There was much confusion, since or-		

	Check	
	Yes	No
ders received thru salesmen went thru the sales department first, while orders received from customers direct went first to the credit man. Can standard procedure overcome such difficulties?		
Kay & Company pay their salesmen a straight commission. Some sell twice as much and therefore earn twice as much as others. Is the sales cost per unit sold the same for all the salesmen?		

Refer to the eight advantages gained thru cost accounting which are listed on page 34 of this manual. Which advantages will prove greatest in the following situations? (Check mark the corresponding number.)

T's big shipments are made in February. He has his factory full of finished parts and partly assembled goods. He wants to borrow money on their value. How can he show their value to a banker?

1, 2, 3, 4, 5, 6, 7, 8.

A purchasing agent had been unusually successful in buying materials at the low points for the year. The general manager took the costs of material and the costs of direct and indirect labor and expenses for the last three months of the year as a basis for new prices. The next year the market price of labor and of materials remained the same, but the profits were disappointing. How could a good cost system have avoided this?

1, 2, 3, 4, 5, 6, 7, 8.

How can a cost accountant help to decide whether to increase or decrease the personnel work in a factory?

1, 2, 3, 4, 5, 6, 7, 8.

When the Chicago sales office suggests that a national sales drive be organized to push copper utensils and the New York office prefers a drive on aluminum ware, how can the cost department help to decide the question?

1, 2, 3, 4, 5, 6, 7, 8.

Two apparently similar branches show approximately the same cost of doing business. The rent of one branch is known to be abnormally high. What feature of the cost system is likely to disclose new opportunities for profit in the other?

1, 2, 3, 4, 5, 6, 7, 8.

After the War, the prices of the raw material used by the Vee Company dropped, but wages remained high. How will a cost system aid the company in maintaining a fair margin of profit?

1, 2, 3, 4, 5, 6, 7, 8.

Executive Problem 37

"WHEN CAN WE MAKE DELIVERY?"

Scheduling the Work Thru the Shop

UNDER THE LASALLE PROBLEM METHOD

* * *

"IF A man stands needlessly idle for twenty minutes, the profit is gone on all he does that day." How important it is, then, so to schedule our work and that of our men that men and machines may be kept constantly busy! Carefully scheduled work also assures a definite delivery date—an essential for profitable marketing.

Prepared by the Research and Consultation Staff of LaSalle Extension University from an interesting problem which it has carefully investigated and analyzed.

Executive Problem 37

"WHEN CAN WE MAKE DELIVERY?"

The importance of an accurate answer to this question will be conceded by every business man. We cannot sell goods satisfactorily unless we can assure the buyer that he will receive them on some specified date. This is perhaps the most apparent reason for definite scheduling of work; no less important, however, are the "internal reasons" for scheduling all the work that goes thru a shop.

When the order of work is left to chance, it will pile up for one machine while others stand idle. Some parts of an order will be completed while other parts are not begun. Large inventories of goods in process with none ready to ship; large investments in materials, and reduced efficiency due to crowded floors; large losses from idle time while men and machines wait for work—these are some of the penalties for poor scheduling of work.

In this problem you are introduced to an organization which has learned the lesson that control thru planning pays, and pays well. It has a simple but effective system of control of work thru the shop—a system which centers around a control board on which orders are scheduled and thus progress thru the shop controlled.

Control systems do not work automatically, however. As the executive manual so truly says, "A control board is not a substitute for brains—planning the moves on the board calls for intelligence, ingenuity, and imagination." Your part in this problem will be to exercise your "intelligence, ingenuity, and imagination" as you plan one day's moves on the control board of the Moore Roller Bearing Company.

Your Company. This company is making a high-grade roller bearing. Its principal customers are automobile and truck manufacturers; it is also supplying bearings to a manufacturer of lightweight self-propelling railway coaches.

Roller bearings have three essential parts: a cup which is fitted into the hub of the wheel, a cone which is fitted to the axle or shaft, and a number of rollers which in this bearing are all assembled in a cage.

The Moore bearing is made in three sizes. This means that it is made up in three diameters so far as the working surfaces of the bearings are concerned. The shape, length, and the outside diameter of the cup, and the shape, length, and the inside diameter of the cone, vary considerably to meet the specifications of the different automobile and truck designers, however.

Manufacturing the Roller Assembly. The rollers are made up from chrome steel rods. After they have been machined, hardened, ground, and sorted for size to the nearest one ten-thousandth of an inch, they are mounted in a pressed-steel cage. We will not concern ourselves further with the rollers. They are made up in quantities and put in stock in each of the three sizes, ready to be shipped.

The Cups and Cones. The cups and cones are machined out of solid bars of chrome steel in large automatic lathes. Each complete series of operations on these "automatics" produces one cup and one cone at the rate of about eleven per hour for the largest sized bearing. These machines must, of course, be very carefully set and adjusted, but once they are operating they require so little attention that one man and a helper can keep four automatics at work.

The only additional machine operation necessary is to trim off the burrs. This is done on a drill press. In the working papers you will find a description of all these machines, and the time required for each operation.

Before the machined cups and cones leave this department, they are carefully inspected as to size. This inspection does not materially delay progress, however, since it is done as fast as the blanks leave the drill presses.

Hardening and Heat Treatment. The low-carbon chrome steel out of which the cups and cones are machined is not hard enough to resist the wear which a bearing gets. These parts, therefore, as well as the rollers, are "case hardened" by packing them in iron containers or "boxes," which are filled with carbon and sealed. The boxes are then placed in an oven and kept at a carefully regulated high temperature for many hours. The carbon is slowly absorbed by the steel, so that each part gets a skin of very hard and rather brittle high-carbon steel. The interior, however, remains unchanged, thus giving the bearing a combination of hard exterior and strong, elastic interior. When the container is withdrawn from the oven, it is allowed to cool gradually. The cold, case-hardened parts are then put thru a heat treatment which brings out the maximum strength of the hard case and the ductile interior. These processes take about forty-eight hours in all.

The Grinding. The metal on the exterior of the cups and cones is now far too hard to machine. It must be ground to size. This work also is done by automatic machinery. The faces of the cups are ground smooth on one type of grinder. The external diameter of the cup is ground on another grinder. Both these operations must be exact, but they do not require that high degree of exactness which is necessary on the inside surface of the cup—the surface on which the rollers turn.

On most of these grinding operations, one man takes care of two machines.

The cones are ground in much the same way. Here, however, the work requires more attention, so that each machine requires an operator.

Inspection. Inspection on this work is extremely thoro. Each cup and cone is inspected for size and for hardness, and is visually inspected to make sure there are no cracks. These inspection processes do not materially delay the completion of the work, since they are going on all the time, as fast as the parts leave the final grinding process.

The Work in the Shop. This company this year has a contract with the Ajax Automobile Company to supply them with 4,000 bearings a week. This is about one-half the company's output when working with one shift of men, as it is doing at present. About one-half of the equipment is steadily employed on Ajax work, therefore. During the summer and fall months, the company put thru orders for a large number of standard bearings. All but one of the urgent orders for standard stock have been completed before January 7, the date when you are to take charge of planning for a day.

The shop has other stock orders in hand, which it can put thru if necessary to keep men and machines busy. These, however, are not urgent, and are not being scheduled just at present, since the sales department has assured the shop that there are a number of nice contracts just ahead, and has asked the shop to keep the tracks clear.

The control board, of which you will find a picture in the working papers, shows the situation in the shop at this time. You will see that practically every order is going thru on schedule time. In fact, some orders are a little ahead of schedule. Order P will get thru the machine shop on the 10th, a day ahead of schedule. The final lot of cups on this order will get thru the grinding department on the 16th, one day ahead of schedule; and the final lot of cones is to be ready on the morning of the 17th. Note, also, that the work is going thru the shop with a nice balance in operations, so that cups and cones are to be completed on practically the same day. It is evident, therefore, that the production manager is doing a good job here. He is to take the day off, and you are to take his place for January 7.

You find on your desk word to the effect that Automatic LA7 has broken down and that it will take a day and a half to repair it. A glance at the control board shows that this means a rather serious interference with production on the Ajax material. The work this automatic was doing can be done by any of the other automatics. How will you handle this?

This matter has hardly been adjusted when the general manager himself comes to your office with a hastily written shop order for one hundred large-sized bearings whose cup length is different from that of the bearings now in stock. He asks how soon you can get this small lot thru, explaining that the Veehon Railway Car Company has telegraphed this order in, with a word to explain that the bearings are needed to complete the running gear of certain light draft trucks which one of the large electric railways is to try out. This order may be an opening wedge into an entirely new field. and must have preferred attention.

With this small order scheduled, you are ready to take up the regular work of the day. You find an order for 1,500 medium-sized bearings which are to be completed if possible by January 24. You are to schedule this order also.

The working papers will give you full data with regard to the time required for each operation on each of these orders. They will also give the number of units per day that the different machines can turn out.

By using these data, and exercising your "intelligence, ingenuity, and imagination" in applying the principles you have just studied, you will find that you can make the moves on the control board which will put this work thru the shop on schedule time.

APPENDIX

Cost Accounting and the General Accounts

The cost accountant co-operates with the general accountant to supply the following data for the monthly and the annual balance sheets:

1. The cost value of materials received.
2. The cost value of materials in stores.
3. The cost value of work in process in the shop.
4. The cost value of goods shipped.
5. The cost value of finished goods ready for shipment.

To see how this is done we will follow the work of an accountant as he closes the manufacturing accounts for the year 1924 in the books of the Acorn Manufacturing Company, and as he reopens them for 1925. We will then note how practically the same procedure will give the value each month for each of the above five items.

Note first the Material Burden Account.

MATERIAL BURDEN ACCOUNT

	Debits		Credits
Purchasing expense.....	$ 4,500.00	Material burden 3½% of invoice cost.......	$10,037.32
Storekeepers' and clerks' salaries	3,500.00	Balance undistributed to purchases and transferred to Profit and Loss Account	762.68
Storeroom expense	1,350.00		
Receiving clerks' salaries	1,200.00		
Transportation	250.00		
	$10,800.00		$10,800.00

The debit side of this account needs little explanation. It shows the totals for the year of the accounts which are considered part of the material burden. The last item—transportation—covers only the freight, express, etc., which was not considered part of the direct cost of the materials received.

During the year the subsidiary Material Burden Account has been credited with the burden charges added to the invoice cost of all material received. Goods are charged to the shop at a cost which includes the cost of buying and storing. (See appendix of Executive Manual 36.) The burden charge is in the nature of a "mark-up" added to the invoice cost to cover buying and storage expenses. The rate for 1924 has been 3½ per cent—a per cent based on the experience of past years. During 1924, however, the business was below normal and the purchases less than anticipated. The sum of these burdens—$10,037.32—is on that account less than enough to distribute all the expenses.

There is, therefore, an undistributed balance in this account which is disposed of by charging it off to Profit and Loss. With this disposition, 1925 starts with a clean slate. Unless conditions promise to improve, however, the material burden used during 1925 should be 3.8 per cent, so as to avoid a repetition of an undistributed balance.

The Material Burden Account shows whether an adequate material burden is being added to the invoice cost of materials to get their true cost. It also gives a basis for figuring what the burden for succeeding years should be.

MATERIAL ACCOUNT

	Debits		Credits
Inventory Jan. 1, 1924.	$ 69,982.00	Materials applied to work in process.....	$284,921.00
Purchases of materials.	286,792.00	Balance $81,890.72	
Material burden.......	10,037.72	Physical inventory 81,630.00	
		Charge to Profit and Loss to reconcile above	260.72
		Inventory Dec. 31, 1924	81,630.00
	$366,811.72		$366,811.72
Jan. 1, 1925 Balance..	$ 81,630.00		

The debit side of this account starts with the inventory value of all the materials on hand at the beginning of 1924. Next is the net total of all invoices for materials received during the year, including freight, and next the total of the material burdens which have been added to these invoice prices. (This last figure is taken from the credit side of the preceding account.)

On the credit side is shown first the net total of the materials issued by the stores department during the year. If the quantities of all materials issued have been exactly measured, and the unit cost computations exactly right, the difference between this total and the total on the debit side should exactly equal the cost of the materials actually in the store rooms.

It is customary to take a physical inventory from time to time to check up on this. Such an inventory has been taken here and gives a total only $260.72 less than the perpetual-inventory total—an extremely close agreement. The difference with the actual inventory is reconciled by a charge against Profit and Loss and the 1925 Material Account opened with the correct inventory cost.

If the cost of materials received plus the proper burden is debited to this account each month, and at the same time it is credited for materials issued, the difference between debit and credit sides will show each month the value of materials on hand. From this account, therefore, the general accountant gets the first two of the five desired results.

1. The cost value of materials received.
2. The cost value of materials in stores.

PAY-ROLL ACCOUNT

	Debits		Credits
Salaries paid	$ 27,322.33	Accrued wages Jan. 1, 1924	$ 7,322.00
Wages paid	208,525.00	Direct labor charged to work in process	160,574.00
Accrued wages (to be paid in 1925)........	4,894.00	Purchasing and stores salaries	7,700.00
		Indirect labor and salaries charged to manufacturing expense ..	65,145.33
	$240.741.33		$240,741.33
		Accrued wages Jan. 1, 1925	$ 4,894.00

The "salaries paid" and "wages paid" debit items on this account come from the treasurer. The cost accountant furnishes the items on the credit side showing how much of the pay roll has been paid for direct labor, how much for stores expense, and how much for indirect labor and supervision. This account must balance—of course, taking into consideration the amount paid in 1924 for work done in 1923, and also the wages to be paid in 1925 for work done in 1924. This last item is carried forward to January 1, 1925, as one of the liabilities which the company must show on its balance sheet.

The purpose of this account is to prove that all the pay roll has been accounted for by the cost accountant, and to show how it is "distributed" among the manufacturing accounts. You will note that the salaries on the debit side of the Material Burden Account above are shown on the credit side here.

MANUFACTURING EXPENSE

	Debits		Credits
Supplies	$ 18,875.00	Manufacturing expense distributed as burden in costing goods manufactured during year	$102,498.54
Indirect labor and supervision	65,145.33	Undistributed balance transferred to Profit and Loss Account	4,493.72
Depreciation	7,050.00		
Insurance and taxes	2,508.00		
Maintenance and repairs	11,880.93		
Miscellaneous expense	1,533.00		
	$106,992.26		$106,992.26

Into the debit side of this account are closed all the subsidiary manufacturing expense accounts. The first item is the total of all the supplies used during the year. The second item is that part of the pay-roll which (see the Pay-Roll Account just above) was distributed to manufacturing expense. The other items explain themselves.

The total of these items—$106,992.26—should have been completely distributed during the year by means of the "burdens" added to the direct cost of all the work that was done in the shop during the year. On the credit side of this account is posted the total of the burdens actually distributed. (The methods of distribution are explained in Executive Manual 38.) This total is $102,498.54, or $4,493.72 less than it should have been, due probably to the fact that business was rather slack and not enough work went thru the shop to absorb the entire burden. This difference is charged off to Profit and Loss, but its cause is very carefully investigated to see what the 1925 burden rate should be and whether or not the burden method should be revised.

WORK IN PROCESS ACCOUNT

	Debits		Credits
Inventory Jan. 1, 1924	$ 41,831.00	Cost of work completed during 1924	$503,927.26
Material used	284,921.00	Cost of unfinished work on hand Dec. 31, 1924	85,897.28
Direct labor	160,574.00		
Manufacturing expense	102,498.54		
	$589,824.54		$589,824.54
Jan. 1, 1925, balance	$ 85,897.28		

This account gives very important information which can be obtained from no other source. In it are brought together all the elements that make up the costs of the finished goods—the material cost, labor of all kinds, and all expenses.

On the debit side you find the cost of unfinished work in the shop at the beginning of 1924. (The balance in this account carried over from 1923.) To this is added the cost of material used during the year (taken from the Material Account above), the direct labor cost for the year (taken from the Pay-Roll Account), and the manufacturing expense distributed during the year (taken from the Manufacturing Expense Account). These last three items include, you will see, everything that goes into the cost of production.

The cost accountant knows the sum total cost of all work completed in the shop during the year, and the difference is clearly the cost of the work in process in the shop.

This balance is an important asset and is, of course, shown in opening this account for 1925.

FINISHED PRODUCT ACCOUNT

	Debits		Credits
Inventory Jan. 1, 1924.	$ 31,758.00	Cost of goods shipped during 1924..........	$495,906.36
Manufacturing cost of goods finished during 1924.............	503,927.26	Balance on hand......	39,778.90
	$535,685 26		$535,685.26
Jan. 1, 1925, balance...	$ 39,778.90		

This account gives us the cost of finished goods ready to ship at the end of any period—an important contribution to the financial statement.

To the inventory at the beginning of 1924 is added the manufacturing cost of the goods completed during the year (taken from the preceding account). From this total is deducted the cost shown by the cost-accountant's ledger for all goods shipped during the year. The balance in this account will then show the cost of the goods on hand ready for shipment.

A physical count was made of these goods, which were then costed at average costs. The result compared so closely with the balance in this account that no adjustment of this item was required. The account is therefore closed by carrying this balance forward to the 1925 Finished Product Account.

* * * * * *

In closing the above manufacturing accounts three debits have been made to the Profit and Loss Account:

Undistributed material burden	$ 762.68
Reconciliation of inventory........................	260.72
Undistributed manufacturing expense..............	4,493.72
Total debit to P. & L. Account................	$5,517.12

This entry must, of course, be made before the general books can be closed.

The net results of the contribution which the cost accountant makes to the financial statement is represented by the following balances after the books are closed for 1924:

Balances in the General Ledger Manufacturing Accounts as of December 31, 1924.

	Debits	Credits
Material Account (Materials on hand December 31, 1924)	$81,630.00	....
Pay Roll (Earned but not yet due)	....	$4,894.00
Work in Process (Cost of unfinished work, December 31, 1924)	85,897.28	....
Finished Product (Inventory at cost)	39,778.90	....

Monthly Statements. A little study will show that if the items listed in the above accounts are entered month by month, monthly balances become available to the executives. These provide a close control on the operations of the entire manufacturing organization. When making these monthly statements it is unusual to make the adjustment entries or to require the complete physical inventories that were made in connection with the yearly closing of the books.

The illustration used here does not show certain refinements in accounting practice which it is often desirable to introduce. Nor must it be understood that the procedure followed in this case cannot be varied. The purpose has been to show by an example from actual practice just how cost accounting dovetails into general accounting, and what important data it furnishes for the monthly and annual statements.

BUSINESS MANAGEMENT

CONTROL THRU COSTS—

Being Executive Manual 38, on Principles of Production, in a Complete Plan of Training and Service for Executive Work

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CONTENTS

CONTROL THRU COSTS

Part I

COLLECTING COST DATA

Page

Cost Control from the Accounting Standpoint.................. 1
The Costs of Separate Operations Are Required............... 2
Methods of Collecting Cost Data.............................. 3
Data Regarding Orders.. 3
Data Regarding Materials..................................... 7
Data Regarding Material Burden............................... 8
Data Regarding Direct-Labor.................................. 8
Checking Time Costs Against the Pay Roll..................... 10
Where the Cost Accountant Gets His Facts..................... 12
Data Regarding Overhead Manufacturing Expense............... 13
Assembling the Cost Data..................................... 14

Part II

ANALYZING AND REDISTRIBUTING COST

The Standing Expense Accounts................................ 16
Distribution of Manufacturing Expenses....................... 17
Allotment of Burdens... 17
The Allotment by Product..................................... 18
Allotments by Weight and by Cost............................. 19
Allotment by Labor... 19
Allotment by Machines.. 24
How to Determine the Machine Rates........................... 26
Uses of Different Burden Allotment Methods.................. 28
Commercial and Nonoperating Costs............................ 29

Part III

HOW COST ACCOUNTING AIDS CONTROL

Control thru Study of Standing Expense Accounts............. 31
The Idle-Time Account.. 31
Comparative Production Costs................................. 34
Predetermined Costs.. 36
Monthly Summaries.. 37
CHECK-UP ON PRINCIPLES....................................... 41
WHAT ABOUT OVERHEAD?—EXECUTIVE PROBLEM 38.................... 43
APPENDIX A—THE STANDING EXPENSE ACCOUNTS..................... 49
APPENDIX B—IS INTEREST A MANUFACTURING EXPENSE?. 50
APPENDIX C—PROFIT EARNED BY A LABOR-SAVING MACHINE.......... 51
APPENDIX D—CLOSING THE IDLE-TIME LEDGER...................... 52

CONTROL THRU COSTS

Part I

Collecting Cost Data

IN PART II of Executive Manual 37 we saw the need and advantages of having an adequate cost system in every business—advantages in accounting and in production and sales control.

Let us now see, in some detail, what cost data must be collected and how these can best be obtained. Later on we shall analyze these data and see how they can best be redistributed or reassembled and presented for the use of executives in the control of production, sales, and administrational activities.

Cost Control from the Accounting Standpoint. First, let us remind ourselves that—

> **One of the primary purposes of cost accounting for production is to show in what proportions the moneys spent have been converted into inventories of materials, of work in process, and of finished goods.**

It is obvious that cost accounting must be exact. Each dollar spent must be accounted for. When John Jones receives $45 for a 45-hour week, the cost accountant considers Jones' time worth $1 an hour. He insists that every hour for which Jones receives pay must be accounted for, so that he may distribute Jones' time, at $1 an hour, among all the jobs Jones worked on that week.

It is the same with material. If, say, brass rods cost 20 cents a pound, the cost accountant must know just where each pound and fraction of a pound of these rods is used, so that he may correctly charge the amount used in each job, thus keeping an exact record of the stock of brass as it is being converted into finished goods.

Likewise in the case of other costs, such as a dollar paid for insurance premiums or for a foreman's salary, all factory overhead must be accurately figured and included in the cost of the goods.

It is thus plain that our sources of cost data must be accurate and complete; otherwise the accountant will not be able to balance his books.

> **Each dollar spent must be represented by a dollar's value of materials or of finished or unfinished goods, or by wasted goods or idle time frankly acknowledged as such.**

This does not necessarily mean, however, that each ounce of materials must be accounted for, or each minute of time. Altho cost accounting requires great accuracy, slight differences due to errors in count may often be adjusted and reconciled without impairing the value of the accounting. All really important differences, however, should be checked to find the errors.

The degree of accuracy must meet accounting standards required for detecting all waste. In gathering together the elements of cost, none should be overlooked. The accountant must balance his books.

The Costs of Separate Operations Are Required. It is not enough that the cost data be sufficiently accurate and complete. To be valuable for control, the cost data must cover each operation separately.

If the direct-labor time and cost of all operations in machining large engine cylinders were charged as a whole on the job ticket, the boring cost might run high and the planer cost low. Yet the total might be the same as on earlier jobs, and the more efficient work of the planer hand would go unnoticed. But when the time required for planing and the time required for boring are recorded separately, the excellent planing work on this job becomes apparent and may be studied and used on future planing jobs, while the boring operation may be studied and improved.

That case illustrates the advantage in recording separately the cost of each operation on each job. Only in this way will the executive get the greatest value from his cost system.

> **Cost accounting data must be compiled on sufficiently detailed operations to enable the executive to assemble information on all elements of the work which he wishes to study.**

Methods of Collecting Cost Data. The cost facts collected will vary in detail in different businesses, depending largely on the way the data are later to be classified.

The order or lot system of classifying cost data has greatest vogue in industries of the assembling type, as when costs are figured on each lot of conveying apparatus or on an order for a complete steam shovel.

The product system of classifying cost data is used where different products requiring distinctly different classes of equipment, and correspondingly different overhead expenses, are made in one plant.

The process or operation classification of cost data is used for a steady flow of goods and where operations or processes have no dividing line between one lot and another, as in brickmaking and sugar refining.

SOURCES OF COST DATA

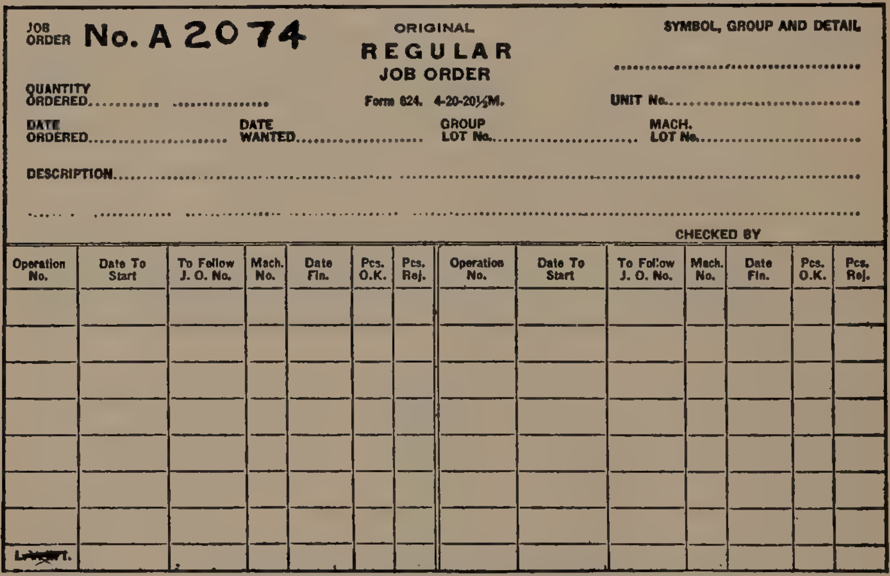
Let us now analyze the sources of cost data; that is, let us find out where the cost accountant gets his cost facts. These sources will be studied in their relation to the following, all of which enter into manufacturing cost:

1. Orders.
2. Materials.
3. Material burden.
4. Direct labor on operations.
5. Factory overhead.

The cost accountant also handles selling expense and administration expense, but we are here interested only in manufacturing cost.

Data Regarding Orders. The cost department needs to have for its own files an exact copy of all orders issued to the production departments, whether stock orders for parts or finished goods or for processing certain quantities of material, or whether for goods made on customers' orders or repair orders.

These orders show the cost department what to expect, so that when material-withdrawal orders, time tickets, and the like come in, they can be promptly and properly handled.



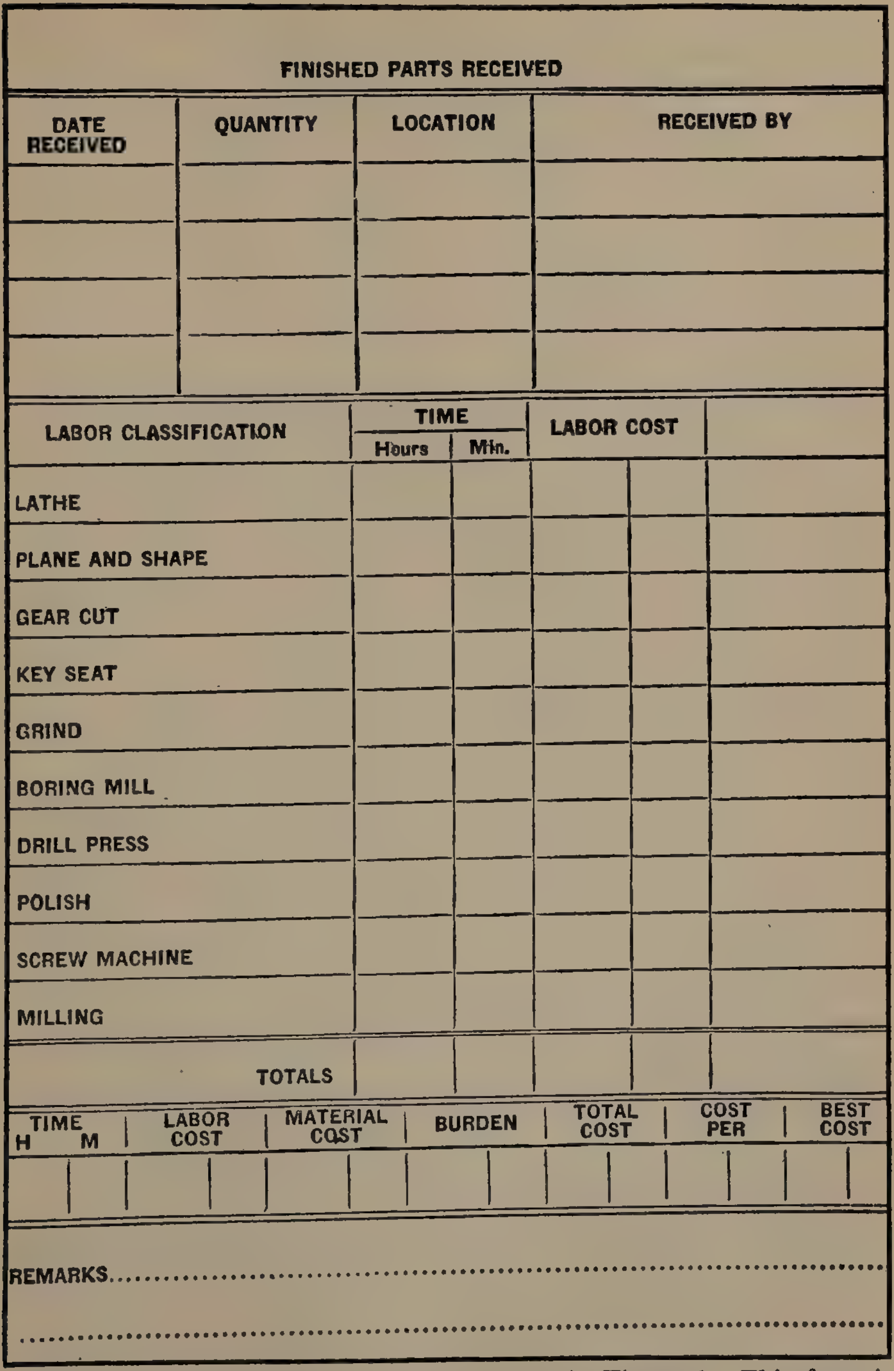
JOB ORDER No. A 2074
ORIGINAL
REGULAR
JOB ORDER
Form 624. 4-20-20½M.
SYMBOL, GROUP AND DETAIL ....
QUANTITY ORDERED.......... ....
UNIT No. ....
DATE ORDERED.....................
DATE WANTED....................
GROUP LOT No. ....
MACH. LOT No. ....
DESCRIPTION...
CHECKED BY

Operation No.	Date To Start	To Follow J. O. No.	Mach. No.	Date Fin.	Pcs. O.K.	Pcs. Rej.	Operation No.	Date To Start	To Follow J. O. No.	Mach. No.	Date Fin.	Pcs. O.K.	Pcs. Rej.
Layout.													

Figure 1. A production-order ticket suitable for handling a number of consecutive operations.

The shipping records must also go thru the cost department, so that it may know just what goods are being shipped out, either from the finished stock or direct from the shop. The clerk in charge of the finished-goods perpetual inventory is often made responsible for contributing information to the cost department regarding shipments.

Orders issued by the production-order clerk, of which the cost accountant gets a copy, should always be arranged with the needs of the particular business in mind. A production order, often called a "job order," is shown



FINISHED PARTS RECEIVED

DATE RECEIVED	QUANTITY	LOCATION	RECEIVED BY

LABOR CLASSIFICATION	TIME		LABOR COST		
	Hours	Min.			
LATHE					
PLANE AND SHAPE					
GEAR CUT					
KEY SEAT					
GRIND					
BORING MILL					
DRILL PRESS					
POLISH					
SCREW MACHINE					
MILLING					
TOTALS					

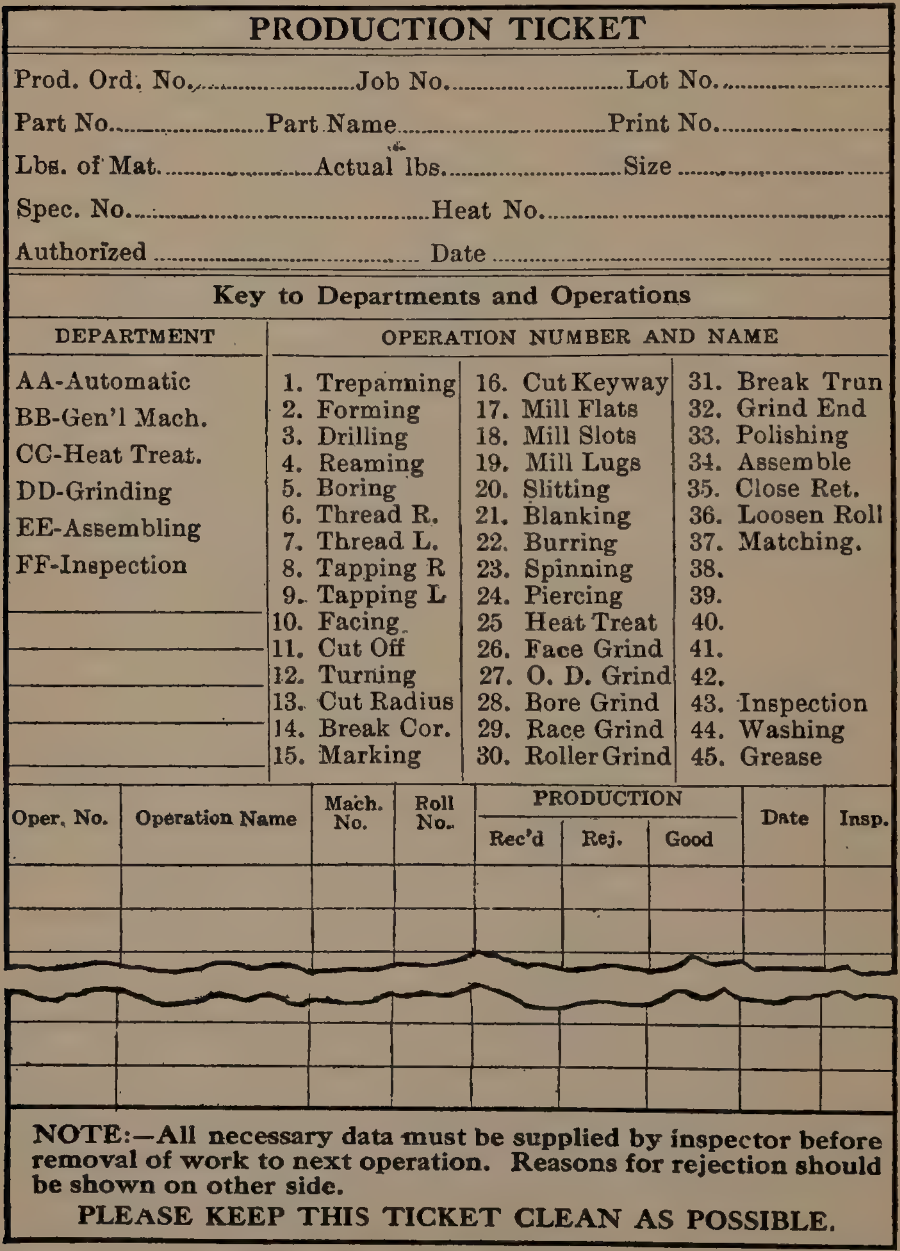
TIME		LABOR COST		MATERIAL COST		BURDEN		TOTAL COST		COST PER		BEST COST	
H	M												

REMARKS..

....

Figure 2. The reverse of the ticket shown in Figure 1. This form is used to compute the total cost and compare it with that of previous similar orders.

as Figure 1. It is admirably arranged for work where several operations are necessary, one after the other, on each lot of pieces.



PRODUCTION TICKET

Prod. Ord. No.................Job No.....................Lot No....................
Part No....................Part Name.............................Print No....................
Lbs. of Mat....................Actual lbs......................Size..........................
Spec. No.......................................Heat No...
Authorized .... Date ....

Key to Departments and Operations

DEPARTMENT	OPERATION NUMBER AND NAME		
AA-Automatic	1. Trepanning	16. Cut Keyway	31. Break Trun
BB-Gen'l Mach.	2. Forming	17. Mill Flats	32. Grind End
CC-Heat Treat.	3. Drilling	18. Mill Slots	33. Polishing
DD-Grinding	4. Reaming	19. Mill Lugs	34. Assemble
EE-Assembling	5. Boring	20. Slitting	35. Close Ret.
FF-Inspection	6. Thread R.	21. Blanking	36. Loosen Roll
	7. Thread L.	22. Burring	37. Matching.
	8. Tapping R	23. Spinning	38.
	9. Tapping L	24. Piercing	39.
	10. Facing	25 Heat Treat	40.
	11. Cut Off	26. Face Grind	41.
	12. Turning	27. O. D. Grind	42.
	13. Cut Radius	28. Bore Grind	43. Inspection
	14. Break Cor.	29. Race Grind	44. Washing
	15. Marking	30. Roller Grind	45. Grease

Oper. No.	Operation Name	Mach. No.	Roll No.	PRODUCTION			Date	Insp.
				Rec'd	Rej.	Good		

NOTE:—All necessary data must be supplied by inspector before removal of work to next operation. Reasons for rejection should be shown on other side.

PLEASE KEEP THIS TICKET CLEAN AS POSSIBLE.

Figure 3. A simple form of production ticket. All the operations used in manufacturing the product are listed at the top of the ticket and are referred to by numbers in all instructions, etc.

Note that columns are provided for "scheduling" instructions. Whether the column headed "Machine No." is filled in in advance by the routing supervisor or is filled in by the department foreman when the work is assigned, depends on the extent to which the planning department directs the details of the work.

Note also that after the "Date Finished" column are two columns which show what parts have passed inspection after each operation and what pieces were rejected.

Figure 2 is the reverse side of this job order shown as Figure 1. The top four lines of Figure 2 provide for information regarding the delivery of the finished goods to stock, while the rest of this form is used by the cost accountants in computing the total manufacturing cost of this job order, to which reference will be made again later on.

Figure 3 shows another effective form of production order, here called a "production ticket." The operations and other data on the lower part of this ticket are filled in by the foremen and inspectors.

Sometimes the order form is printed on a tag which is attached to the part that is to be processed.

Data Regarding Materials. In order that the cost department may have a record of all the material that comes in, copies of all the receiving department's reports of materials received are sent to the cost department. A form of this report was shown in Executive Manual 36.

In order that the materials may be correctly priced, the cost department should receive either the original or a copy of each invoice. If the original invoices are sent to the cost department, the routine of handling them must be such that it will not delay the attention these invoices must receive in other departments.

The cost department must credit the stores with the proper amount for all materials withdrawn from the storeroom. It is necessary, therefore, that all withdrawal orders on the storeroom (see Figures 10 and 11, Executive Manual 36), as well as all credit slips for returned materials, be sent to the cost department.

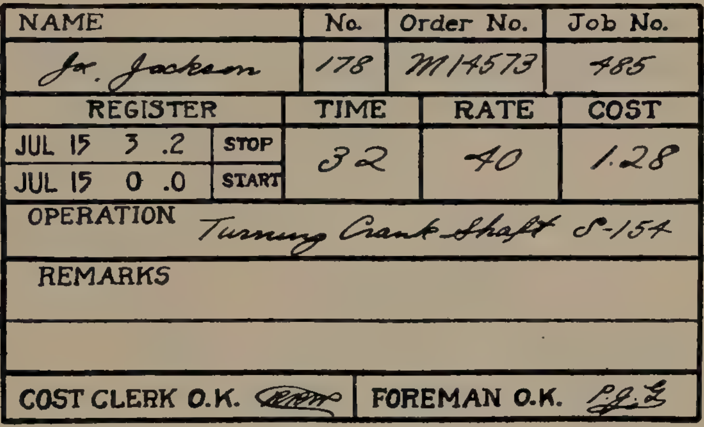
The above procedure duplicates some of the work which the stores clerk must do. That is why in many organizations the perpetual inventory is put into the hands of a man who works for both the stores and the cost departments.

Data Regarding Material Burden. In order that the cost department may compute the proper material burden, the general accounting department supplies it with information concerning incoming freight and hauling cost; also with the total salaries and wages, the cost of traveling, and other expenses incurred in the purchasing, receiving, and stores departments. (This was fully explained in the Appendix to Executive Manual 36.)

Data Regarding Direct Labor. The cost department must charge all the time put in by every employe, in the correct proportion and at the correct rate of pay, either to work in process or to overhead expense, as the case may be—or account for it as idle time. It is necessary, therefore, that the employment or the pay-roll department furnish the cost department with the names of all workers, the rate of pay, and the date of employment of each worker. A list of all employes who leave the firm, giving date of leaving, and all other necessary facts, must also be supplied so that the cost department records will always be up to date.

The cost department receives from the department foreman or from the planning department a record of the exact time put in on each production order or expense order by each employe. This information is given to the cost department in various ways. For workers who are steadily engaged at the same work, such as firing the boilers, or running an elevator, or tending a rotary kiln in a cement mill, the foreman will usually turn in a weekly time sheet showing the time each man put in and the work he did. This sheet will show time put in on repair jobs, and idle time, if any, as well as time spent on the regular work.

Where one job takes considerable time, as when a large number of parts are run thru one process, the time a man begins and ends the job is noted on the job ticket for the operation. In addition, it is necessary to report to the cost department, at the end of each day or week, the time a workman has put in on any unfinished job. Otherwise his time would not be regularly accounted for.



NAME	No.	Order No.	Job No.
Jo. Jackson	178	M14573	485

REGISTER		TIME	RATE	COST
JUL 15 3 .2	STOP	32	40	1.28
JUL 15 0 .0	START			

OPERATION Turning Crank Shaft S-154

REMARKS

COST CLERK O.K.

FOREMAN O.K.

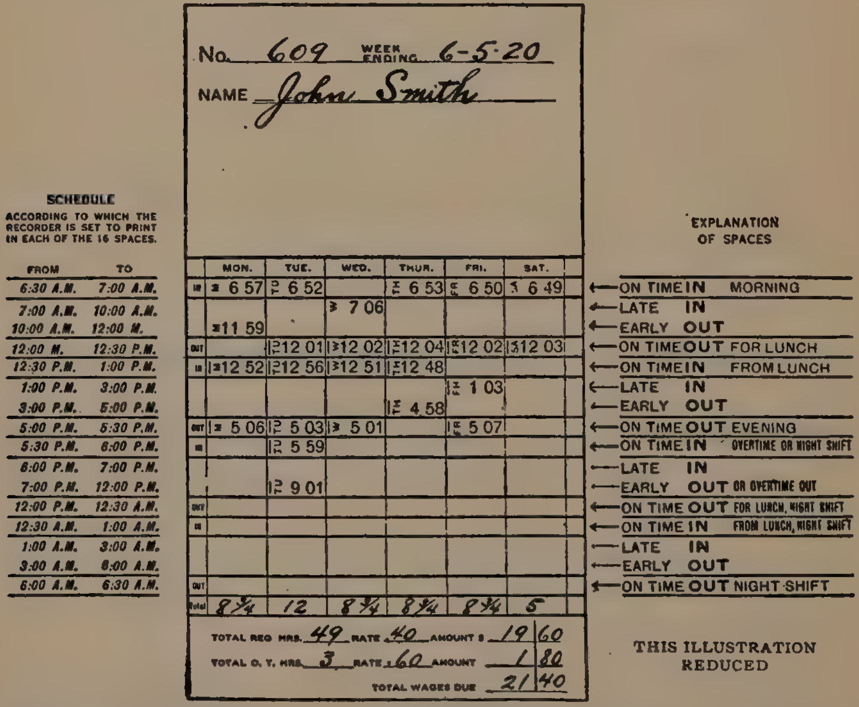
Figure 4. A work ticket is turned in each day for each job the worker has handled.

The usual practice is for each worker to turn in each day a work ticket on each job on which he has worked. A typical work ticket is shown as Figure 4.

The total of all the times shown on a worker's daily work tickets must agree with the time shown on the worker's clock card (see Figure 5) which goes to the payroll department to show the time he has put in.

Sometimes a combination work and daily time card is used, like that shown as Figure 6, which represents one day's time and work. At the top are spaces for the time-clock records of "In" and "Out" hours, while below are spaces on which the workman lists the jobs he works on. He inserts the card in the department time-stamp clock to record when he begins and ends each job. Such a card is well suited for businesses where a man works on several different jobs during a day, as in an automobile repair shop.

When work tickets for each job are turned in daily, the separate slips can be filed either back of guide cards or in envelopes. This does away with posting all the time data from a general time card or sheet to the various cost records.



No. 609 WEEK ENDING 6-5-20
NAME John Smith

SCHEDULE
ACCORDING TO WHICH THE RECORDER IS SET TO PRINT IN EACH OF THE 16 SPACES.

EXPLANATION OF SPACES

FROM	TO		MON.	TUE.	WED.	THUR.	FRI.	SAT.		
6:30 A.M.	7:00 A.M.	IN	6 57	6 52		6 53	6 50	6 49		←ON TIME IN MORNING
7:00 A.M.	10:00 A.M.				7 06					←LATE IN
10:00 A.M.	12:00 M.		11 59							←EARLY OUT
12:00 M.	12:30 P.M.	OUT		12 01	12 02	12 04	12 02	12 03		←ON TIME OUT FOR LUNCH
12:30 P.M.	1:00 P.M.	IN	12 52	12 56	12 51	12 48				←ON TIME IN FROM LUNCH
1:00 P.M.	3:00 P.M.						1 03			←LATE IN
3:00 P.M.	5:00 P.M.					4 58				←EARLY OUT
5:00 P.M.	5:30 P.M.	OUT	5 06	5 03	5 01		5 07			←ON TIME OUT EVENING
5:30 P.M.	6:00 P.M.	IN		5 59						←ON TIME IN OVERTIME OR NIGHT SHIFT
6:00 P.M.	7:00 P.M.									←LATE IN
7:00 P.M.	12:00 P.M.			9 01						←EARLY OUT OR OVERTIME OUT
12:00 P.M.	12:30 A.M.	OUT								←ON TIME OUT FOR LUNCH, NIGHT SHIFT
12:30 A.M.	1:00 A.M.	IN								←ON TIME IN FROM LUNCH, NIGHT SHIFT
1:00 A.M.	3:00 A.M.									←LATE IN
3:00 A.M.	6:00 A.M.									←EARLY OUT
6:00 A.M.	6:30 A.M.	OUT								←ON TIME OUT NIGHT SHIFT
		Total	8¾	12	8¾	8¾	8¾	5		

TOTAL REG HRS. 49 RATE .40 AMOUNT $ 19 60
TOTAL O. T. HRS. 3 RATE .60 AMOUNT 1 80
TOTAL WAGES DUE 21 40

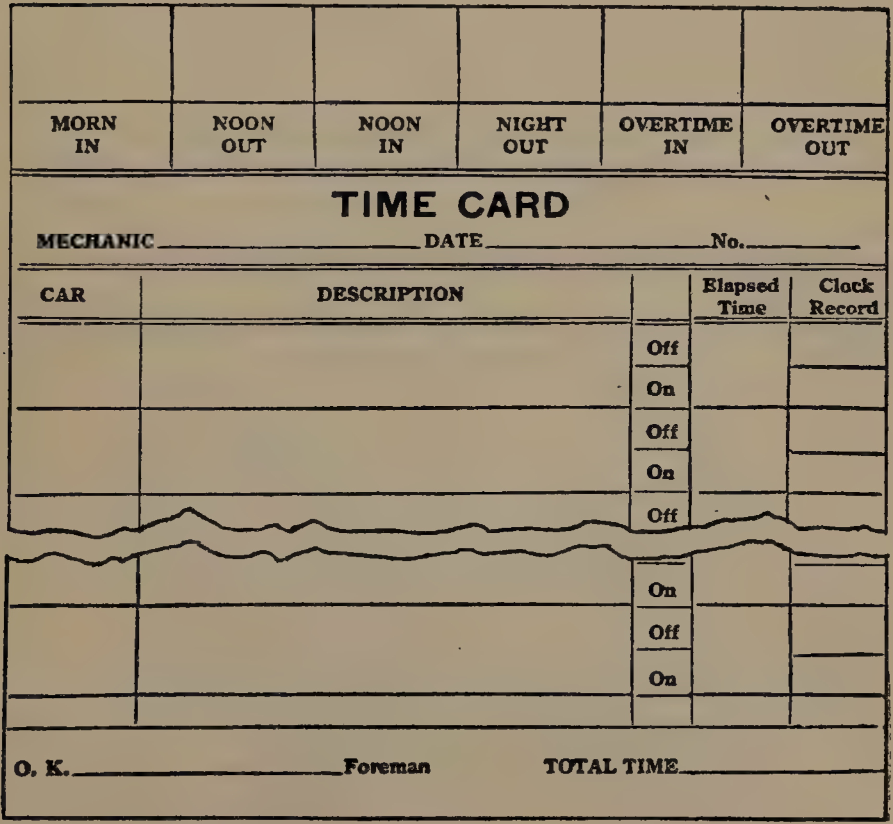
THIS ILLUSTRATION REDUCED

Figure 5. A time-clock card on which the worker himself records the hour and minute when he arrives and leaves, by inserting the card in a specially designed time clock. The meaning of the spaces is explained in the margin. The total time shown must check with the total time shown on the work tickets illustrated in Figure 4.

Checking Time Costs against the Pay Roll. The money value of time charged against various production orders and expense orders each week or month must total exactly the same as the total shop pay roll for the period. In making this check-up, it is customary to use a "distribution-of-labor sheet" for each shop department. This distribution-of-labor sheet shows the hours of work of each employe in the department and the kind of work he did.

The work as shown on this distribution-of-labor sheet is then classified and the amounts paid are shown. This is an important record for making comparisons which reveal opportunities for improvements.

The total money value of labor shown on all the de-



MORN IN	NOON OUT	NOON IN	NIGHT OUT	OVERTIME IN	OVERTIME OUT

TIME CARD

MECHANIC________________ DATE________________ No.________

CAR	DESCRIPTION		Elapsed Time	Clock Record
		Off On		
		Off On		
		Off		
		On		
		Off On		

O. K.________________ Foreman TOTAL TIME________________

Figure 6. A time card suitable for automatic recording of time "in" and "out," and also for listing the jobs done during the day and the time devoted to each.

WHERE THE COST ACCOUNTANT GETS HIS FACTS

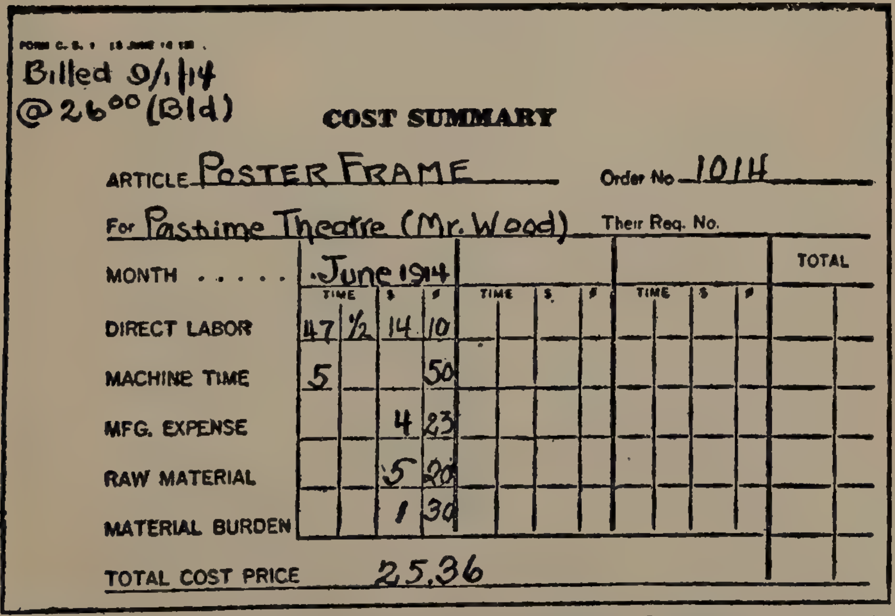
Group I. Orders.	(a) From production department.	1. Copies for all shop stock orders for detail-part replenishment. 2. Orders for assembling groups or making finished goods, special repair parts, or repair orders.
	(b) From shipping department.	Copies of all shipping orders.
Group II. Materials.	(a) From stores manager.	All withdrawal orders on storeroom.
	(b) From receiving department.	Copies of all lists of materials received.
	(c) From purchasing agent.	Copies of all invoices or prompt advice as to quantities and prices of all goods purchased.
Group III. Material Burden.	From accounting department.	1. Totals of inward freight and hauling. 2. Totals of purchasing department, receiving department, and stores department, salaries and wages, as well as cost of supplies used, traveling, and other expenses in these departments.
Group IV. Direct Labor.	(a) From employment department.	1. Names of all persons employed together with check number, rate of pay, and exact date of employment of each worker. 2. Names of all persons quitting, together with exact date of quitting and check number.
	(b) From timekeeper.	1. Exact time put in on each production or expense order or operation by each employe. 2. Distribution of each man's work during every pay period, such distribution to be checked against pay-roll time and money paid.
	(c) From cashier.	Copies of all pay rolls.
Group V. Manufacturing Expense.	(a) From accounting department.	1. All administrative and clerical salaries. 2. All supervisional shop salaries. 3. All fixed charges, such as depreciation, taxes, insurance, etc.
	(b) From the system of standing orders and standing expense accounts.	1. Expense material, such as cotton waste, machine oil, etc. 2. Indirect labor charged to standing expense orders. 3. Variable plant charges covering power, lighting, heating, plumbing, repairs, maintenance, etc.

Figure 7. An outline of the sources of cost facts used by the cost accountant.

partment cost records for a given month must be the same as the actual shop pay roll. To get an exact balance, however, entries covering the cost of fractional hours may be increased or decreased by a cent or two here and there.

Data Regarding Overhead Manufacturing Expense. The cost of overhead shop expense is arrived at thru a system of "standing orders" represented by fixed numbers, covering such items as machine repairs, janitor service, materials (including cotton waste, machine oil, etc.), and all variable plant charges, such as power, lighting, etc., which are totaled monthly.

The general accounting department supplies to the cost department facts concerning all administrative expense, such as executive and clerical salaries; all fixed charges, such as depreciation, taxes, and insurance; and all special manufacturing items, such as legal and patent expenses.



Billed 9/1/14
@ 26^{00} (Bid)

COST SUMMARY

ARTICLE POSTER FRAME Order No. 1014

For Pastime Theatre (Mr. Wood) Their Req. No.

MONTH	June 1914												TOTAL	
	TIME		$	¢	TIME		$	¢	TIME		$	¢		
DIRECT LABOR	47	½	14	10										
MACHINE TIME	5			50										
MFG. EXPENSE			4	23										
RAW MATERIAL			5	20										
MATERIAL BURDEN			1	30										

TOTAL COST PRICE 25.36

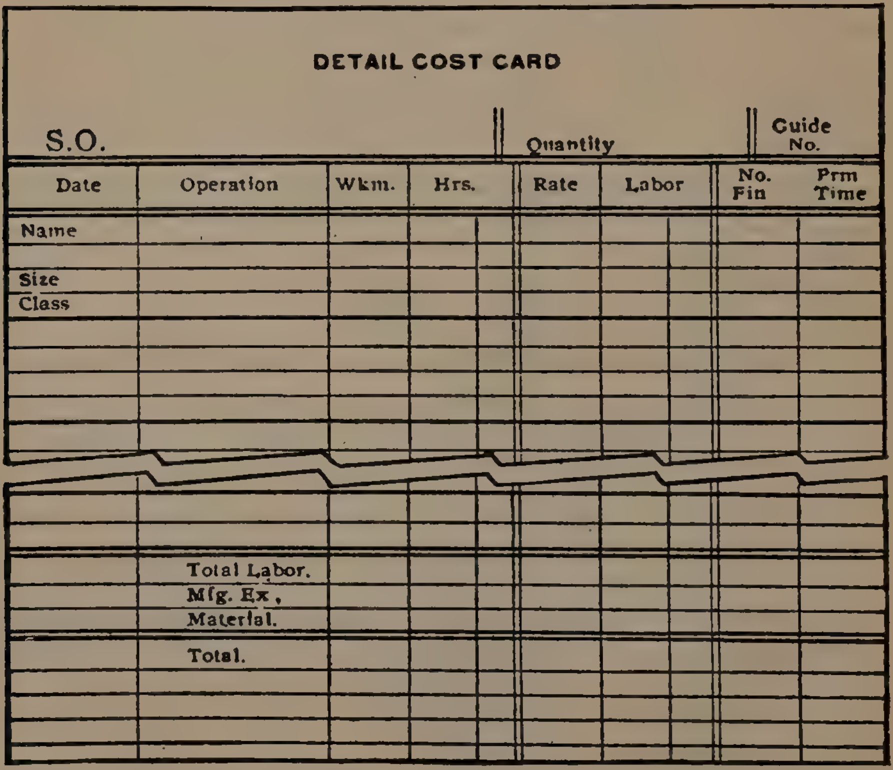
Figure 8. The face of a stiff manila envelope designed to contain material-withdrawal orders and job-time cards or time tickets. The totals from these tickets are posted each month in the columns shown.

Part II of this manual will outline the various methods by which these overhead-cost data are effectively used in determining and distributing the expense burden.

Figure 7 gives a summary of all the various sources of cost facts that flow into the cost-accounting department.

Assembling the Cost Data. When a copy of a production order, variously called "job ticket," "work order," "factory order," or "schedule of production," is received in the cost department, provision is made properly to record and file the data that will soon flow in regarding the costs.

Ordinarily these data, as they flow in, are kept in a stiff manila envelope, shown as Figure 8, which can be filed in a standard filing-case drawer. The envelope used is designed to hold the copy of the job order, the material-



DETAIL COST CARD

S.O.				Quantity		Guide No.	
Date	Operation	Wkm.	Hrs.	Rate	Labor	No. Fin	Prm Time
Name							
Size							
Class							
	Total Labor.						
	Mfg. Ex.						
	Material.						
	Total.						

Figure 9. Typical cost-posting card to which times are transferred from work tickets or department time sheets. This plan is being superseded by the envelope plan shown in Figure 8.

withdrawal slips, and the time slips after they have been checked against the pay-roll time.

The printing and columns on the face of the envelope, as shown in Figure 8, are designed to make it easy to show the standing of the order at the end of each month, as well as to show when the job is completed. The totals on the outside of the envelope are a condensed cost analysis of the job up to date.

These envelopes may vary in capacity from an ordinary flat envelope designed to hold a dozen or more papers to the bellows type of envelope designed to hold bunches of slips. The envelope method of filing time and material records is gaining in favor because it saves a large amount of copying. The earlier method was to post all labor costs from time cards to large sheets, one of which was prepared for each order number. Sometimes a separate section of the sheet and often a separate sheet was used for each kind of part on a given shop order. Figure 9 illustrates a typical cost card of this sort still used by many companies.

In the old days the smith bought his iron from the founder and forged it into chains and swords and plowshares. His equipment was inexpensive, and naturally there was little or no indirect labor cost.

Of late years production has gained tremendously in efficiency thru the use of labor-saving machinery and thru proper organization. These developments are not gained without cost, however; a cost which is reflected in the overhead charges of industry. In fact, it may be said that—

> **Overhead expenses in production are in general the extremely moderate wages which industry must pay for the wonderful modern improvements in industrial efficiency.**

In Part II of this executive manual we shall see how overhead is distributed in figuring the correct cost of each item manufactured.

CONTROL THRU COSTS

Part II

ANALYZING AND REDISTRIBUTING COST

THERE is no question about including the cost of the leather used when the cost of making a pair of shoes is figured. But what share of the expense of renting and running a large number of expensive special machines shall be applied in figuring the cost of a pair of shoes, and what share of the expense of heating and lighting the plant shall be applied?

Such questions are now to be answered in order to gain a grasp of cost accounting that will enable us to understand fully how cost accounting aids in the control of a business, as explained in Part III of this manual.

In our previous study of cost accounting we analyzed the cost facts to be obtained. We saw how all the direct costs of material, labor, and direct expenses can be assembled for each job, and even for each operation on the job. We also saw the elements which make up indirect costs or overhead expenses, and the sources of cost facts on these elements.

How group these elements? How determine what proportions of overhead expenses are to be added to one operation or job and what to another? These questions will be answered in following pages.

The Standing Expense Accounts. The general manager wants to know how such items as building repairs and maintenance for the preceding quarter-year compare with the same expenses for previous quarters. The accountant, therefore, opens an account in his books, called a standing expense account, in which he puts all building maintenance and repair expenses.

The works manager wants to know each month how his power bill compares with previous averages. For this expense, and a great many more, the accountant has standing expense accounts, so that he can give the executives at any time a comparison of present with past expenses.

The usefulness of these expense accounts for checking up on varying expenses is evident.

> **Cost accounting gives the executives an important control over expenses by presenting them in a form in which it is easy to study and compare them.**

Appendix A on page 49 gives a list of the standing expense accounts into which many firms find it profitable to divide their expenses.

Distribution of Manufacturing Expenses. Certain indirect costs and expenses were grouped together in Figure 12 of Manual 37 as overhead factory or manufacturing expenses.

In some industrial plants, where comparatively little machinery and supervision is required—as in a plant where bar copper is converted into copper wire—the indirect manufacturing expenses will be much less than the direct costs; but in many other industries, indirect overhead expenses run about the same as direct costs, while in not a few industries, they are greater than direct costs.

In any event, however, it is important to have an accurate distribution of indirect expenses in order to determine the true total cost of products, parts, operations, etc. Let us see how this distribution, or "allotment of burdens," may be made.

ALLOTMENT OF BURDENS

The addition to the cost of any product which results from adding the overhead manufacturing expense is usually called the "burden." This burden may be allotted or distributed in several ways, as follows:

1. By product.
2. By process.
3. By department.
4. By labor.
5. By machines.
6. By a combination of the above methods.

The Allotment by Product. The simplest method of distributing the overhead is to allot an equal share to each unit of product; for example, to each barrel of cement made in a cement mill. In this case, the direct expense, such as power used, foreman's time, and the like, is figured as part of the direct cost of producing a barrel of cement. The fixed charges and the general manufacturing supervision, however, in a cement mill may amount to, say, $3,000 a month. If the mill turns out 20,000 barrels of cement a month, this gives a burden of 15 cents to add to the direct cost in order to obtain the total manufacturing cost of each barrel.

In continuous-process manufacturing of one or of very few similar products, the above method of allotting the overhead burden is satisfactory. Another example is the making of mineral or vegetable oils, where the product and the processes are fairly uniform. But if there are different classes of product with different processes, it becomes necessary to divide the manufacturing overhead expense into groups. One group will include expenses common to all products or processes, and others will include expenses peculiar to certain classes of products or processes. The total overhead burden is made up for each product or process by adding the overhead burden which applies to that particular product or process to the burden that applies to all products or processes in common.

This same reasoning applies to allotment by departments. Some of overhead expenses apply equally to all departments. Others apply to particular departments only or in different percentages to various departments.

Allotments by Weight and by Cost. Sometimes the allotment of burden is made by weight, as in foundries and rolling mills, where there may be different burdens for different classes of castings. All of the castings must bear a certain burden per pound for the expenses common to all castings. In addition, there will be a class rate per pound to cover such expenses as are peculiar to each class of castings.

Another method of allotting expenses by product is to distribute the expense on the basis of the cost of material. Where the price of the material is uniform, this method gives practically the same result as an allotment per unit of finished product. Where the material varies in cost, however, this method cannot be applied. It would be manifestly wrong to charge an article made out of brass with seven or eight times the burden charged on an article made out of iron in the same plant simply because the raw material in the brass article costs seven or eight times as much as the raw material in the iron article costs.

Allotment by Labor. Probably the most widely used method of adding manufacturing overhead expense is by allotting it in proportion to the direct labor employed in production. There are two ways of doing this, as follows:

1. By distributing the overhead in proportion to the direct-labor cost, called the percentage-on-direct-labor method.
2. By distributing the overhead in proportion to the hours of direct labor, called the hourly expense method.

The Percentage-on-Direct-Labor Method. Under the first of these two methods, an accurate record is kept of all wages that have been included as direct cost items on production orders. All other wages will, of course, find their way, thru various accounts, into the manufacturing overhead expense account.

At the close of a month or a quarter or a year, the total of direct-labor costs for the time in question is compared with the total of manufacturing overhead expenses, including all indirect-labor costs.

If the direct-labor costs in one period are $100,000 and the manufacturing overhead expenses during the same period are $150,000, then the manufacturing overhead expenses are 150 per cent of the direct-labor costs. Thus, in this case, 150 per cent of the direct-labor cost of every piece, assembled group, or completed product is added to the combined cost of direct labor and material to arrive at the total manufacturing cost.

For example, our cost records might show that a spur gear had required ten hours of direct labor at 60 cents an hour, making a total direct-labor cost of $6. Our manufacturing expense burden would be 150 per cent of $6, or $9, making the combined cost of direct labor and manufacturing overhead expense $15. If the material cost $2, including material-burden charges, the total manufacturing cost of the spur gear would be:

Material cost	$ 2.00
Direct labor cost	6.00
Manufacturing overhead expense	9.00
Total manufacturing cost	$17.00

The percentage-on-direct-labor method of adding manufacturing overhead expense, as above explained, is to-day the most widely used method. It is the simplest of all methods to apply in a general manufacturing plant and the easiest one to figure.

Where the men engaged in direct production all receive about the same wage and where there is little machine expense or where the machine expense per worker is about uniformly the same, this method of figuring in the manufacturing expense burden works well. But if the rate of pay for the same kind of work varies, or if some workmen do more work and others less work per hour—which is essentially the same as differences in the rate of pay—then this method of allotting overhead expenses does not work so well.

Suppose a lower priced man takes twice as long to do the work as a higher priced man would take. Then the job as done by the lower priced labor uses the floor space, power, light, heat, mechanical transportation, supervision, and indirect-labor factors of the shop twice as long as when the higher paid man does the work. This variable of time is not provided for in the percentage-on-direct-labor method. Therefore, there has been a tendency among progressive manufacturers to abandon the percentage-on-direct-labor method and to substitute for it the method of allotting the overhead expense burden to the hours of direct labor.

The Hourly Expense Method. Under the hourly expense method, an accurate record is kept not only of the total wages charged directly against production but also of the total time of all this direct labor. All other labor costs and all other factory overhead costs find their way ultimately into the overhead manufacturing expense account.

The total hours spent in direct labor during a definite period are calculated. The manufacturing expense burden for the same time is divided by the total hours of direct labor, and the quotient gives the hourly overhead-expense rate to be added to each hour of direct labor.

In favor of this plan is the fact that rent, taxes, depreciation, and all other fixed charges, as well as most variable plant charges, vary directly with the time. Under this method of allotment, a job which takes ten hours of direct labor is charged with twice as much manufacturing overhead expense as a job which takes five hours of direct labor in the shop.

Taking the same case used to illustrate the percentage-on-direct-labor method, presented on a preceding page—the case where the direct-labor costs in one period were

$100,000—suppose that the total of direct labor hours during that period was 200,000. The total overhead manufacturing expense was $150,000. Thus 75 cents an hour is the rate of overhead expense to be added to the costs of direct labor and material, including material burden, in figuring the total manufacturing cost.

Making the spur gear took ten hours of direct labor at 60 cents an hour, a direct-labor cost of $6. Ten hours of overhead manufacturing expense at 75 cents an hour is $7.50, to be added as the overhead expense burden. Suppose, however, that the direct-labor cost of $6 had represented fifteen hours of labor at 40 cents an hour, then the overhead manufacturing expense at 75 cents an hour would be $11.25, to be added as the expense burden. But as figured under the percentage-on-direct-labor method, the expense burden to be added would have been the same in each case. Only if the work were done at 50 cents an hour and in twelve hours would the amount of expense burden to be added be the same when figured by both methods.

Comparison of the differing results under the two methods of allotting expense burden, as illustrated above, demonstrates the fact that a carefully planned method of distributing the expense burden is required in accurate cost accounting.

The National Machine Tool Builders' Association and certain other organizations have adopted the hourly expense rate for the sake of uniformity, as well as for its greater accuracy in manufacturing lines of the synthetic or assembling type.

The Local and General Burden Rates. No matter which of the above methods of distributing manufacturing overhead expenses is used, one difficulty will have to be met.

If more than one line of products are manufactured, how is the expense burden to be allotted so as to charge it fairly against the several departments?

Suppose two lines are made, one requiring light machinery and much bench work, and the other requiring heavy machinery and little bench work. Shall both lines be charged the same hourly (or percentage) rate of manufacturing expense burden? If so, would not costs thus figured be too high on the light-machinery and much-bench-work line, and too low on the heavy-machinery and little-bench-work line? How can this defect be avoided?

This difficulty is sometimes met by separating all manufacturing expense items that are common to all departments from those which apply only to specific departments. A general rate of expense burden common to all departments is established; also an equitable local rate is established for each department or group of departments, which represents its proportional share of expense burden.

Such a division relieves all bench and vise work from any overhead arising from operation of the machine shop. This division of expense is computed on the hourly expense basis of burden allotment by dividing the direct-labor cost and time for a given period according to departments or groups. For example, take the following group of costs and labor hours:

Direct-Labor Costs		Direct-Labor Hours
Small-machine shop	$ 50,000	100,000
Heavy-machine shop	25,000	50,000
Vise and floor work	25,000	50,000
Total	$100,000	200,000

Assume that the overhead manufacturing expense is divided as follows:

General overhead	$ 65,000
Small-machine shop	25,000
Heavy-machine shop	50,000
Vise and floor work	10,000
Total	$150,000

Dividing the general overhead of $65,000 by 200,000—the total of direct-labor hours—gives a general overhead burden of 32½ cents an hour.

Dividing the small-machine shop expense of $25,000 by 100,000, which is the total direct-labor hours in this shop, gives a local expense burden rate of 25 cents an hour for this shop.

Dividing the heavy-machine shop expense of $50,000 by 50,000, which is the total of direct-labor hours in this shop, gives a local burden rate of $1 an hour for this shop.

Dividing the $10,000 of vise and floor work expense by 50,000 direct-labor hours gives a local burden rate of 20 cents an hour in this shop.

Thus the three hourly local rates are:

In small-machine shop, 25 cents.
In heavy-machine shop, $1.
In vise and floor shops, 20 cents.

The general hourly expense burden of 32½ cents an hour added to each of the three group gives the total hourly expense burden for each group as follows:

Small-machine shop, 57½ cents.
Heavy-machine shop, $1.32½.
Vise and floor shops, 52½ cents.

It is evident that, if costs are figured on the above basis, satisfactory comparisons may be made with costs in any other firm that uses the same method, no matter how different the lines may be. Furthermore, where light and heavy products are built in the same plant, the above modification of the hourly expense method of allotting overhead expenses is necessary if costs are to be accurately determined. This kind of accuracy is particularly necessary in cases where price competition is stronger on one part of a line of products than on another.

Allotment by Machines. The method of allotting the manufacturing expense burden to the different machines, rather than on the basis of labor hours, is a practice which has been followed for many years in planing mills and in job machine shops. This method as used in these establishments is commonly known as "the old type of machine rate." In applying it, the entire manufacturing expense burden is apportioned to machines only.

Assume that there is a total manufacturing expense of $150,000. An estimate is made of the total number of hours that each machine is run and the machines are grouped according to type. To each of these groups of machines a portion of the manufacturing expense burden is allotted. By dividing this group burden by the total hours which the group of machines was operated, the hourly rate for each machine is computed.

Each machine must bear its share of the expense burden by being charged an hourly rate for its time. To get the overhead cost which is added to the direct cost of a job, this hourly rate or burden for each machine used on the job is multiplied by the number of hours each machine was used on the job.

This old type of machine rate does not establish local or general burden rates distinct from the machine rate, but it distributes the entire manufacturing expense burden by means of the machine rates.

The more modern machine-rate method allots to each machine or group of similar machines only its actual share of manufacturing expense burden. This naturally leaves a part of the total manufacturing expense burden which is not chargeable to any particular machine. This part of the expense burden is then covered by additional burden rates, which may be—

1. A general overhead rate only, or
2. Both a local, or departmental, and a general overhead rate.

The allotment of burden by a machine rate to which is added both a general and a local overhead rate is, for many industries, a very accurate and satisfactory method of apportioning the manufacturing expense.

How to Determine the Machine Rates. The first step in determining the overhead machine rates is to analyze the overhead manufacturing expense accounts carefully and to select the accounts which exist partly or wholly because of the ownership and operation of machinery. These expenses include such items as a share, based upon the space occupied by machines, of the charges for depreciation of buildings, for taxes, and for insurance; all charges for depreciation of machinery; that portion of the small-tools account which represents tools used on machines; that portion of power charges which represents power used in driving machines; in short, every item of overhead manufacturing expense incurred by reason of operating the machinery.

Having thus determined the total of the overhead manufacturing expenses that must be borne by all of the machines, the next step is to allot the proper portion of this total to each machine. This is done by charging an hourly rate for its services. In determining this rate it is necessary to know the approximate power consumption of each machine, its rate of depreciation in value, the rapidity with which it wears out small tools, the expense of maintaining the machine in good repair, the extent and value of the floor space it occupies, the material storage and handling space required in using it, and all other expenses chargeable against the particular machine. To get the machine rate we divide the foregoing total expense by the normal working hours of the machine during the period for which we accumulated the expense.

Having thus determined the rate of overhead expense burden that applies to a particular machine, the actual time during which the machine is used on a job is multiplied by this rate to get the machine burden to be added to the direct costs of the job.

Adding a General and Departmental Rate. A sizeable portion of overhead manufacturing expense remains after the part that is chargeable to all the machines is deducted. This will usually be distributed by adding a general and a departmental rate of burden based upon the hours of labor that were used in operating the machine on a job.

Again, take the case of the spur-gear job which was considered earlier. In that case an efficient man could complete the job in ten hours at a direct labor cost of $6. The total annual overhead manufacturing expense was $150,000.

Careful analysis shows that $80,000 is the portion of this total overhead that is directly incurred from operating all the machines. Of this portion, $1,100 is the amount to be charged annually against the milling machine used on this job.

The normal working time for this machine is found to be 2,000 hours a year, which is approximately 90 per cent of the total working time. Dividing $1,100 by 2,000, gives an overhead machine rate of 55 cents an hour for this machine.

Overhead machine rates are established for all other machines in the same way, thus accounting for $80,000 of the total overhead manufacturing expense, which was $150,000. Thus there remains $70,000 to be allotted by general and local hourly rates.

The general overhead expense to be distributed in this case is $40,000. The total departmental overhead is $30,000, of which $8,000 is the proper share for this particular department. The total of direct-labor time in this department is 50,000 hours, while the total of direct-labor time in this plant as a whole is 200,000 hours.

Dividing the $40,000 of general overhead expense by 200,000 hours gives a general hourly overhead expense rate of 20 cents. Dividing the $8,000 of departmental overhead expense by 50,000 hours gives a local or departmental rate of 16 cents an hour.

For this department, therefore, the general and the departmental hourly rates added to the direct-labor time total 36 cents.

Adding together all the above elements which enter into the total manufacturing cost of this spur-gear job gives a total of $17.10, as follows:

Material, including material burden			$ 2.00
Direct labor	10 hours @	$0.60 an hr.	6.00
Machine time	10 hours @	.55 an hr.	5.50
General and local burden	10 hours @	.36 an hr.	3.60
Total manufacturing cost			$17.10

It is apparent that if a less-skilled workman had taken fifteen hours for this job at 40 cents an hour instead of 60 cents an hour as the direct-labor cost, the direct-labor cost would have been the same, but the overhead manufacturing expense (machine time and general and local burden) would have been $4.55 greater.

It is also apparent that if the man who did this job in ten hours had used a much larger machine with a machine time cost of, say, $2,500 a year instead of $1,100, the machine-time rate would have been $1.25 an hour instead of 55 cents an hour, making the machine-time cost on this job $12.50 instead of $5.50, even tho other costs remained the same.

Uses of Different Burden Allotment Methods. We have now covered the different methods of distributing or allotting overhead manufacturing burden. Which one is the best for any particular shop? Briefly, it may be said that—

Allotment by product is usually a satisfactory method where few products are made, and where these few are similar with respect to the kind of work done in making them. Even under such conditions, however, it is often necessary to adopt a local, or departmental, and a general burden rate in order to have a sufficiently accurate distribution of overhead.

Allotment by percentage-on-direct-labor cost is satisfactory where all the workers get about the same pay, do similar work, and use similar equipment. Where these conditions obtain, this method may be adequate, and it is very easily applied.

Allotment by direct-labor hours is more accurate than the percentage-on-direct-labor method in cases where different grades of men are employed and especially where different types of machines are used and different burden rates are worked out for workers using different machines. Obviously, this method is satisfactory for a wide range of plants or shops.

The machine-time method, combined with a local and general burden on labor hours (the last method explained above), applies successfully under almost any set of conditions. It is most accurate because it considers the time value of equipment as well as the time value of labor. This method also affords an incidental advantage in "Idle Time Control," which will be explained in Part III of this manual.

COMMERCIAL AND NONOPERATING COSTS

As indicated in Figure 12 of Executive Manual 37, total operating cost consists of commercial costs (administrative and selling expenses) in addition to manufacturing cost. There are also certain nonoperating costs to be added, which are not shown in Figure 12, such as interest, discounts, and extraordinary expenses of one kind or another. How interest enters into costs is explained in Appendix B.

In previous pages we saw how manufacturing cost is analyzed and figured—how direct costs (consisting of raw materials and material burden, direct labor, and direct expense chargeable against a particular job) are added to overhead factory expense, and how overhead factory expense is distributed or allotted to particular jobs.

A problem often faced by management is whether or not it will pay to add a certain labor-saving machine to the present equipment. A satisfactory solution of this problem requires accurate knowledge of complete costs with and without the labor-saving machine. The total cost of owning and operating the new machine, including all direct and indirect expenses, must be lower than the present cost for an equivalent amount of work. Appendix C at the end of this manual presents a formula for exactly computing how much profit, if any, can be expected from adding any labor-saving machine or device.

An expensive labor-saving machine may be made to pay a profit by working it sixteen or twenty-four hours a day, with two or three shifts of operators, because certain overhead expenses on the machine, such as rent on the space it occupies and interest on the money invested in it, go on accumulating at the same rate per day no matter how many hours per day the machine is operated. The more hours per day it is operated, the lower is this overhead burden per hour on this machine.

It is clear that an expensive machine is not likely to be a profitable investment unless it is kept busy. All idle machine time, as well as idle labor time, runs up costs. How control of idle time and other leaks in production is aided by cost accounting will be explained in following pages.

CONTROL THRU COSTS

Part III

How Cost Accounting Aids Control

THE purpose of cost accounting is to aid the management in so controlling a business as to make it permanently profitable. This aid is gained in three ways, as follows:

1. Thru constant study of each standing expense account and each standing job order to detect variations from normal.
2. Thru constant study of the direct-labor cost, the material cost, and the overhead cost for production operations and for complete jobs, in comparison with costs on similar work—work done elsewhere as well as work done earlier in the same plant.
3. Thru an analysis of monthly reports in which the results of operations are summarized.

Control thru Study of Standing Expense Accounts. Scrutiny and comparison of repair costs, bills for power, and all similar standing expense accounts are an obvious aid to control of costs, as explained in Part I of this manual.

An executive can also watch and control general tendencies toward too great extravagance, or too strict economy, in such matter as the use of supply materials, such as machine oil, soap, brooms, and the like. It is just as poor economy to use a worn-out broom and take much more time to sweep a floor in order to avoid buying a new broom as it is to use more than the right amount of machine oil.

The Idle-Time Account. One set of standing expense accounts is so important from the standpoint of control that it should be given special consideration. This is the idle-time account—idle men and idle machines.

When a workman jams his finger and loses time on that account, should the time lost be charged to the job he is doing? And what about the time lost when a jig breaks in the middle of a job and both workman and machine must wait while it is being replaced? And how about the idle time of the man who has to wait while a previous operation is being finished before he can go on his next job? What about labor time and machine time when there is not enough work in the shop to keep all the machines and all the operators busy all the time?

The Idle Time of Men. Idleness of men is largely avoidable. A good foreman will keep it down to a minimum.

There are in almost all shops certain jobs which may be done at almost any time, such as department repair jobs, machine adjustments, and the like. Rather than have men standing idle, they can be assigned to such work at times when they would otherwise be idle.

Workers may be temporarily or permanently laid off, if absolutely necessary, to avoid long periods of idleness. But, if possible, they should be assigned to other work rather than be laid off.

Under the best of management, however, there is likely to be a certain amount of idle time. (Idle time does not include rest periods, but only the time when a man is not at work apart from allowed rest periods.) This idle time should all be charged to an account or job order which covers this expense alone, with an explanation for each item, such as "Injury to finger," "Waiting for jig repairs," etc.

Under no circumstances should a foreman permit his men to charge idle time unfairly to any production order.

> **Tolerating dishonest distribution of the time a workman spends at various tasks tends to encourage dishonesty in other ways.**

Furthermore, the costs of a job to which idle time is unfairly charged will obviously not permit an accurate comparison with the cost of similar jobs, altho this defect, serious as it is, is not as serious as the effect on the shop morale when an essentially dishonest practice is tolerated.

Executives get valuable information regarding the value of the safety devices which prevent accidents, of the efficiency of the planning-department work, of the methods used by shop foremen, etc., from a study of the idle-time account for the men. How about idle machines?

Idle Time of Machines. As previously explained, the hourly rate of cost charged against a machine is based upon its normal time of operation. The normal working time of a machine is determined by deducting the unavoidable idle time from the total working time.

Numerous surveys have been made to determine the causes of idleness of equipment. Even where there is enough work on shop orders to keep all the equipment busy, it has been found that there is, on the average in industrial establishments, an idleness factor of about 5 per cent due to absences, an idleness factor of about 10 per cent due to lack of material (usually an evidence of poor planning, preparation, and scheduling), and an idleness factor of approximately 2 per cent due to breakdowns and repairs.

Thus the normal working time of a machine, on the average, is about 17 per cent less than the total working hours. By careful planning of work, however, it is possible in many industries to reduce this average percentage of idleness.

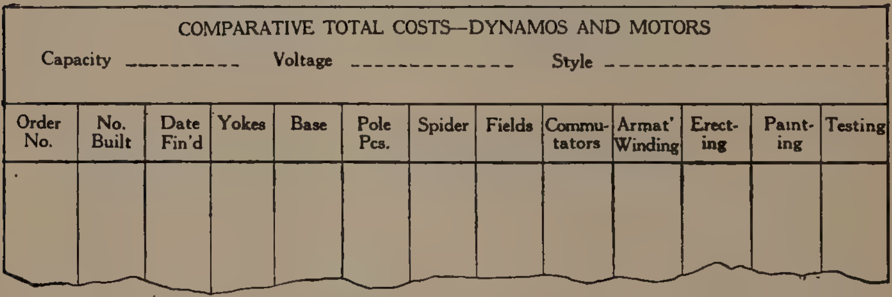
Where a business is of a seasonal nature, such as fruit and vegetable canning, the active time of the equipment will be a much smaller portion of the total possible time. In ordinary manufacturing, however, costs and competitive selling prices are based on the use of the equipment at its normal capacity, which ranges in various plants from 10 to 20 per cent less than the total working time.

The idle time of all machines should be accounted for as well as the running time; and the idle time, its cost, and the reasons for idleness should be entered in an idle-equipment account for each department. A study of these accounts gives the executive valuable information needed in making decisions on additions to the plant, in planning new work to keep all the equipment busy, etc. These accounts also afford a means of checking up the efficiency of a planning department.

What to do with the idle-time account balances is explained in Appendix D at the end of this manual.

COMPARATIVE PRODUCTION COSTS

In Part I of this manual we saw how cost information on each production or job order is classified and recorded as it comes into the cost department. The manufacturing overhead expenses are then added, as explained in Part II of this manual, and the total manufacturing cost can then be computed—

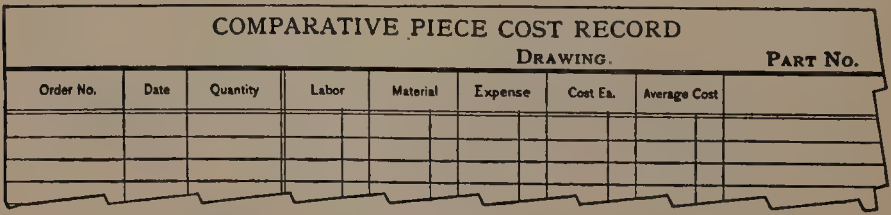


COMPARATIVE TOTAL COSTS—DYNAMOS AND MOTORS

Capacity ________ Voltage ____________ Style ____________________

Order No.	No. Built	Date Fin'd	Yokes	Base	Pole Pcs.	Spider	Fields	Commutators	Armat' Winding	Erecting	Painting	Testing

Figure 10. A form for comparing total costs of assembled product.



COMPARATIVE PIECE COST RECORD

DRAWING. PART NO.

Order No.	Date	Quantity	Labor	Material	Expense	Cost Ea.	Average Cost	

Figure 11. Individual-part cost record.

1. For the job.
2. For individual parts.
3. For individual operations.

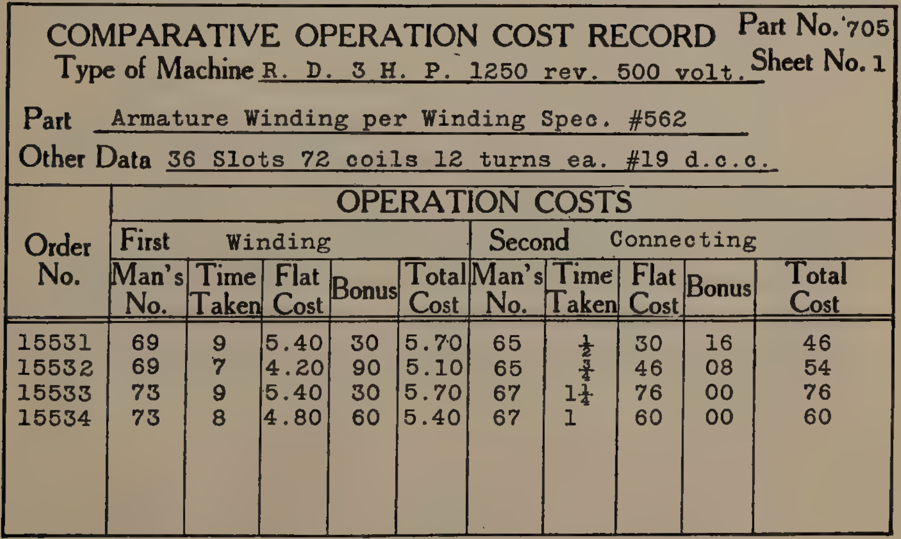
The total costs on a certain proportion of the jobs, if not on all of them, are computed for comparison with past costs on similar work. The more detailed studies and comparisons are made only on enough jobs to enable the cost accounting to be of adequate aid to management in controlling production.

Figure 2 on page 5 of this manual shows how the total cost is assembled. This card is designed for use where the overhead burden is distributed by departmental burden rates based on labor time.

Note that the last three items on the form provide for—

1. Total cost of the job.
2. The cost per unit.
3. The best cost per unit that has been made previously.

In making a record of comparative total costs of an assembled product, it is necessary only to prepare a card index or loose-leaf binder in which are listed the chief groups which make up the total cost. Figure 10 illustrates a form for recording comparative total costs



COMPARATIVE OPERATION COST RECORD Part No. 705
Type of Machine R. D. 3 H. P. 1250 rev. 500 volt. Sheet No. 1
Part Armature Winding per Winding Spec. #562
Other Data 36 Slots 72 coils 12 turns ea. #19 d.c.c.

Order No.	OPERATION COSTS									
	First Winding					Second Connecting				
	Man's No.	Time Taken	Flat Cost	Bonus	Total Cost	Man's No.	Time Taken	Flat Cost	Bonus	Total Cost
15531	69	9	5.40	30	5.70	65	½	30	16	46
15532	69	7	4.20	90	5.10	65	¾	46	08	54
15533	73	9	5.40	30	5.70	67	1¼	76	00	76
15534	73	8	4.80	60	5.40	67	1	60	00	60

Figure 12. Operation cost record.

of dynamos and motors. A study of these comparative total costs shows the management what the shop efficiencies are now as compared with what they have been. Such records also aid in estimating the cost of a new design of the same product.

Figure 11 illustrates a comparative total-cost record of individual parts. This comparative cost record serves as a basis for preparing price lists on repair parts and also in showing the results of improved shop methods as they affect costs.

Figure 12 is an operation-cost record. The entries on this record show the relative cost of the leading operations performed by various workmen or groups of workmen; they aid in determining the efficiency of employes, and they provide data for bonus or premium plans either for this work or for new but similar operations.

The comparative operation-cost record is often used to establish standard times and costs, but it presents only a record of the best that has thus far been done and, of course, is not a substitute for time and motion study, which study is the scientific way to determine how long the various operations should take. A comparative operation-cost record, however, gives information which is not disclosed by time and motion studies, since it deals with rates of pay, bonuses, and actual total costs.

Predetermined Costs. After departmental overhead expenses and machine rates, accurately worked out, have been in use for some time and after comparative cost facts have been accumulated on direct material and direct labor, it becomes possible to establish definite standards, quotas, and budgets which are valuable aids in management.

Records of past performance, while accurate in themselves, may not constitute a sound basis for cost predetermination or budgets. Investigations of various sorts, including time and motion studies and "methods engineering" (that is, determining with engineering precision whether the tools, fixtures, and machines in use at the present time constitute the best methods), must precede any final budgets or cost predetermination.

Established standard budgets of labor, material, expense for each product, departmental operation costs, etc., are goals which the foremen and the men are expected to attain. Such budgeting or quota setting is known as "predetermining costs." These predetermined or standard costs must not be exceeded. Usually some incentive is offered to the workers and the foremen, which gives them a special reward for attaining the fixed standards and at the same time maintaining quality.

Predetermined costs are the logical outcome of cost accounting which accurately shows the methods that are most profitable and are therefore the methods to be set up as standards.

MONTHLY SUMMARIES

The president, the general manager, and the other officials of a company find effective aids to control in the monthly reports which the cost accountants prepare.

In planning monthly reports, it is necessary to define "monthly," for the calendar month, as a rule, does not work well in cost accounting, since the months of the year vary in length. It is usual, therefore, to have certain months arbitrarily made up of five full weeks and the others of four weeks.

A plan that is commonly used divides the year into four thirteen-week quarters. The first month in each quarter is always considered to include five full weeks and the other two months of each quarter are each just four weeks long.

It is obvious that such an arbitrarily consistent division into months is necessary for the sake of accurate monthly comparisons.

Reports Containing Accounting Data. Among the most important reports that the cost accountant prepares are those which give cost facts which are useful in making up the monthly financial balance sheet. These reports will include the following data:

1. Data regarding material:
    (a) The value of the material received during the month.
    (b) The value of material used in manufacturing during the month.
    (c) The inventory value at the close of the month.
2. Data regarding labor costs: A summary of the pay roll for the month by departments, showing distribution to—
    (a) Direct labor.
    (b) Indirect labor.
3. Overhead expenses:
    (a) A summary of the manufacturing overhead expenses for the month.
    (b) The distribution of overhead burden showing the amounts allotted to each department.
4. Work in process: A summary of the cost of orders in process analyzed as to material cost, direct-labor cost, and overhead burden, and listed by departments.
5. Finished goods:
    (a) A summary of the cost of all orders completed during the period, analyzed as to material cost, direct-labor cost, and overhead burden.
    (b) Goods delivered during the period.
    (c) Inventory of finished goods.

Supplementary Reports. Executives can use much cost information in addition to that above outlined.

The president and the general manager of a company like to get unit costs for each type of product each month and a comparison of these costs with previous costs. They like to get a statement showing the quantities of the principal raw materials and the principal finished goods which are at present in the stores.

The general executives also like to have a periodic statement showing how overhead expenses compare with past periods. A summary of the standing accounts gives much of this information.

The executive also wants to know the efficiency of each operating department expressed in whatever unit is most suitable for the business in question. He wants a summary of the idle time of the equipment in each department. He wants a brief statement of departmental output, number of employes, total pay roll, and comparative unit costs.

Both the cost accountant and the executive should remember that—

> **In proportion as the cost accountant presents his facts as information which makes useful comparisons possible and easy, will his reports be valuable as an aid in control thru costs.**

Suggestive Production Information. The exact types of information which cost records can give the executives will vary with each industry. There are certain questions, however, which almost every executive likes to have answered, such as:

1. Are the operating expenses, considered for each department separately, higher or lower than in the past? What is the reason for each change?
2. Is the total cost of making a product higher or lower than in the past, and what is the reason for the change, if any?
3. To what extent is volume of output responsible for variations in cost?
4. How do the costs of each unit of product manufactured compare with the selling price? What quantities of each unit are being sold?
5. What is the percentage of indirect labor to direct labor for each producing department? How does this compare with the company's standard and with standards in other companies.
6. What is the rate of turnover of material carried in the storeroom? What is the average period of manufacture from storeroom to finished product? What is the average length of time that finished goods are carried in stock?
7. What is the labor turnover?

The cost accountant gathers facts which enable him to prepare reports on all the above-mentioned points. These reports aid all branches of management in shaping their plans and in checking up on the success of their plans. Thru his various reports, the cost accountant gives to the executive facts and comparisons which are vital as a means of controlling activities for which the executive is responsible. That is why it is so important to understand cost accounting as explained in this manual and in Part II of Executive Manual 37.

Cost accounting is not only an essential element in the control of production, enabling the works manager and his associates to know their costs and to check up on the merits of various methods and plans, but it is also an equally essential element of control in the financing department, the sales department, and in the general administration of a business. Every executive is effectively aided in controlling the activities for which he is responsible thru intelligent scrutiny, analyses, and comparisons of costs.

Executive Manual 39 will take up one of the most vital and most interesting problems of current industrial management—that of directing the man power in attaining low-cost production. And by "low cost" is meant a minimum cost in the way of trouble and worry, wear and tear, and mental and physical strain endured by a force of workmen, as well as low money cost of labor, which does not necessarily mean the paying of low wages. But before starting Executive Manual 39, clinch your grasp of cost accounting by using the following check-up on principles and then working out Executive Problem 38, which you will find to be very interesting and exceedingly helpful in rounding out your training in executive work.

CHECK-UP ON PRINCIPLES

Use the following check-up to get the principles of this manual firmly fixed in mind. This will help you to handle the problem which follows. This check-up is entirely for your own personal use, so you need not send it to the University.

	Check	
	Yes	No
1. A company's cost statement showed that overhead expense was much higher than the direct-labor cost. A public speaker procured a copy of this and exhibited it as proof of the "inefficiency of industry." Is this a fair deduction?		
2. The overhead expenses of the following companies are distributed in various ways. Will the methods indicated give a fair distribution of costs?		
(a) In the loom department of a carpet-weaving company, the entire overhead (both general and departmental) is distributed on the machine-hour basis.		
(b) In a pattern shop making complicated wooden patterns for use in a brass foundry, the entire overhead is distributed by the labor-hour basis.		
(c) In a gold mine all overhead is distributed by the machine-hour basis.		
(d) In the fitting room of one shoe factory (the department where uppers are assembled, as described in Executive Problem 35) all indirect costs including general overhead are distributed on the labor-cost basis.		
(e) In another shoe factory all overhead allocated to the fitting room is distributed on the labor-hour basis.		
(f) In a basket factory the overhead for all the hand operations (whose operators all work on straight piecework) is distributed by the direct-labor-cost basis.		
(g) In one flour mill general overhead is distributed on the basis of cost of wheat purchased.		
(h) In another flour mill this expense is distributed on the basis of bushels of wheat purchased.		
(i) In a third flour mill the distribution is based on the barrels of flour produced.		
(j) In a large printing plant, all costs are distributed on the labor-hour basis.		

	Check	
	Yes	No
3. The Abbott Advertising Novelty line proved so unpopular in 1923 that it did not sell well, and many of the expensive multicolor lithographing presses stood idle for weeks at a time. The designs were selected by the general management without consulting the sales manager. Would it be fair in these circumstances to consider the sales department responsible for the idle-time expense of these presses? (See Appendix A.)		
4. A two-color printing press costing some $30,000 is used on work for which it is desired to compute the total cost, including interest on the investment. A $10,000 share of the general plant investment should be added to the cost of the press to get the original total plant investment for which it is responsible. The press is no longer new, however, and this original value must be depreciated by $7,500. The company pays 7 per cent for its capital. Considering the normal working time of this press as 2,400 hours a year, will $1 an hour of machine time be too high as a supplementary interest-burden rate? (See Appendix B.)		
5. A coal-handling and automatic-stoker equipment for a factory power house will cost $3,300, installed. It will dispense with the labor of one man, whose wages are $120 a month. The general overhead charged to this man's time is $15 a month. The use of this equipment will result in a fuel saving of about $80 a month, because of the more efficient firing of the coal. The money invested in such an equipment will cost the company 6 per cent. Insurance, taxes, depreciation, and other fixed charges will cost 14 per cent. Maintenance, supplies, and similar charges will be $60 a month. Assume that the plant runs the year round. Will it pay to buy it? (See Appendix C.)		
6. If the plant runs but six months a year, will it pay to buy?		

Executive Problem 38

WHAT ABOUT THE OVERHEAD?

Allocating the Manufacturing Expense Burden

UNDER THE LASALLE PROBLEM METHOD

* * *

"OUR high overhead is the reason for our unusually low production cost." In the plant of which this was said, automatic feeders, conveyors, and other labor-saving devices had made "common labor" almost unknown. Overhead costs were high—but profitable.

The distribution of these overhead costs to the different kinds of work is a real problem—a problem whose correct solution is essential in such cases as the following pages describe.

Prepared by the Research and Consultation Staff of LaSalle Extension University from an interesting problem which it has carefully investigated and analyzed.

Executive Problem 38

WHAT ABOUT OVERHEAD?

In the office of the Dodge Box Company, of Forestville, Mr. McBride, the president and manager, Mr. Julius, the office manager, and Mr. Samson, the superintendent, are having a conference. After a word of greeting, Mr. McBride plunges into the subject which he has called the others to consider.

"Our cost system must be wrong!" he begins. "Let me tell you what has happened."

Mr. McBride then describes the interview he has had the previous afternoon with his very good friend, Mr. Londer, of the Londer Remedy Company, the largest buyer of box shooks in Forestville. (Box shooks are the sides, ends, top, and bottom of an unassembled box.)

When the Londer Remedy Company was small, it had been a customer of the Dodge Box Company. The Londer Remedy Company had grown rapidly, however, and about three years ago put in a box-nailing machine. It then purchased box shooks in carload lots and assembled them in its own shipping room. At that time the Dodge Box Company was working overtime and did not care for box-shook orders; now, however, business is rather dull, and an order for a carload of box shooks will be very welcome.

Mr. McBride finds that Mr. Londer is perfectly willing to give him a share of his box-shook purchases, but, naturally, he insists that Mr. McBride meet the prices which are being quoted by out-of-town firms. Mr. McBride has figured on the business, but has been unable to get his prices down to a point where he can meet outside prices. At yesterday's interview Mr. Londer told him frankly just what competition he is up against, and Mr. McBride has called this "council of war" to consider what they can do.

After telling of the interview, Mr. McBride continues:

"I'm willing to take that shook order at cost, in order to keep our plant going at full capacity. Yet the prices Londer is getting are below what we figure as our cost on these shooks. I don't want that business if it has to be taken at a loss. The competition we get on complete boxes seems to show that the costs of other box factories are no lower than ours. In fact, I don't see how they can be, for we have as efficient a plant and organization as you'll find anywhere. Yet our prices on box shooks are out of line.

"I've studied the matter from every angle. I am convinced that our cost system must be wrong, and that I am getting the wrong cost figures for these shooks.

"Can either of you men tell me what these shooks actually cost to make?"

Both men are silent for a moment. Then Mr. Julius replies:

"Neither one of us is an accountant, as you know. Helen (the bookkeeper) is very conscientious and absolutely reliable so far as the accuracy of her figures is concerned. She knows nothing about the theory of cost accounting, however.

"Our costs are being figured in accordance with a system that was put in three years ago by Mr. Brophy, just before he died. He told me that he was following a cost system adopted by the National Association of Box Manufacturers. I am by no means sure, however, that Helen is doing things exactly as Mr. Brophy had planned.

"We have always seemed to get excellent results from this cost-accounting system. Our costs on finished boxes seem to be in line with those I hear about from other manufacturers, and we seem to get a perfect distribution of all our overhead expense. There is nothing left over at the end of the year to charge off to profit and loss."

"I have no fault to find with our cost figures on finished boxes, but these costs estimates on box shooks are certainly wrong!" replies Mr. McBride.

"Samson, you're taking a course in Business Management with LaSalle Extension University. Have you learned anything about cost accounting there?" As Mr. Samson nods in the affirmative, Mr. McBride continues:

"Suppose you study this situation and see if you can tell us where the trouble lies. Our figures are accurate. Of that I haven't a doubt. There must be something wrong in the way in which we are using these figures."

(The description that follows should be carefully read to get a clear idea of the manufacturing process. While the process may at first seem rather complex, you will find that the questions and schedule on the working papers will help you to analyze it so that you can choose a cost system which will give accurate results.)

This is what Mr. Samson finds as a result of his investigation:

How Wooden Boxes Are Made. In this factory, low-grade 1-inch lumber of various—"random"—widths is used, which is bought in carload lots. About 3,000,000 board feet a year are used. (The process of manufacture varies quite considerably in different plants.) A yard force of three men unload the incoming cars, stack the lumber, load each day's requirements on small cars, and push them into position for the planer man to handle.

Both sides of the board are planed in one operation. It then goes to the slasher—a machine having a number of crosscut saws—where the slasher man squares off the ends, and saws the board into the lengths required for the sizes and kinds of boxes that are on order. This man must be an expert to use the lumber to best advantage. The operator has the day's requirements in mind, and cuts the lumber so that the ends of the pieces have no knots, so that a minimum is wasted in leftovers, etc. This requires careful judgment and rapid handling.

Some pieces are now of proper size to make the ends for small boxes. Other pieces go to a band saw, known as a "resaw," where they are sawed to half thickness to make the sides for small boxes.

In order to meet the specifications of most orders, however, many of the pieces must be matched and fitted to make a box end, side, top, or bottom of proper width. This is done on three tables, each of which is provided with a rip saw to trim the edges of the pieces.

From this operation the side and top-bottom sets of pieces which are to be resawed to one-half or one-third thickness go to the band resaw.

If the edges of the pieces are to be tongued and grooved, or overlapped, a proper allowance is made in matching, so that after the pieces go thru the machine which does this, the complete side, top, or bottom is the exact size wanted.

Most shooks need no further processing. The tongued and grooved pieces, however, must be matched and squeezed together. If the ends are to be printed, they are now run thru a printing press; cleated ends must be nailed; lock-corner ends and sides must be run thru a process which cuts grooves in the ends of the pieces.

Shooks which are sold as shooks are tied into bundles. When the orders call for complete boxes, however, the shooks must be "set up." They go on trucks to nailing machines, where the sides are nailed to the ends, and the bottoms next nailed in place. For lock-corner boxes the side and end shooks are glued and squeezed together and the bottoms nailed. Bundles of tops are delivered with the boxes.

The Present Cost System. This company considers the yard cost, planing cost, and slasher cost as part of the material cost, and adds it to the price paid for the lumber to get the cost per board foot of the material used. The reason for this is that when a board is cut to box lengths, it may go into several different boxes. It is impossible, therefore, to apportion the earlier operations to any special lot of boxes.

All the overhead—manufacturing, sales, and administrative—is in this company distributed as a percentage added to the direct-labor cost. The material cost therefore is figured as the price paid for the lumber plus freight; plus the labor cost of the three yard men, the planer and slasher operators, and their two helpers—seven men who together receive $28 a day; plus an overhead burden which is 142 per cent of the wages of the above men, or $39.76 a day. This crew of men handles an average of 250,000 feet of lumber a month. The average labor and burden cost which is included in material cost is therefore $6.78 per thousand feet.

There is a certain unavoidable waste in cutting up the lumber and in manufacturing boxes of the sizes that are specified. The number of board feet in each style and size of finished box is known. Knowing the quantities of each size made, and also the amount of lumber planed, the percentage of waste can easily be computed. For the previous year this proved to be 16 per cent, which means that 84 per cent of the lumber that was run thru the planer was actually used.

In figuring the cost of material, this percentage is used and the price paid per thousand feet plus the $6.78 described above is divided by .84 to get the total cost of the material used.

The costs of all succeeding operations, such as matching, printing, nailing, etc., are obtained by adding the same percentage of burden (142 per cent) to the direct-labor cost of the operator. Only a few of the operations require much skill. Some operators earn $6 a day, others as little as $3 a day. All the helpers, truckers, foremen, etc., in these departments are considered indirect labor, and their wages are distributed as part of the general overhead.

The overhead also includes all machine expense. Some of the machines, e. g., printing machines, are automatic, and require little attention. Machines for some operations are rarely worked full time.

The factory makes about 70 different sizes and styles of boxes, and monthly cost cards are kept for each. All direct labor is charged to one of these cards. The cost of materials used, such as nails, lumber, etc., is computed from the amount required to make a finished box. All overhead of every kind is distributed as indicated above.

The Londer Box-Shook Specifications are simple. Boxes of three sizes are required, to hold 2 dozen, 3 dozen, and 4 dozen bottles. Ends and sides to be 7½ inches wide, and ¾ inch and ⅜ inch thick, respectively. Tops and bottoms to be ⅜ inch thick, planed on one side, and overlap matched. No printing.

Ends and sides will be cut from 8-inch stock. Ends are completed on the slasher. Sides are resawed to half thickness. Top-bottom sets must be assembled and trimmed on matcher, sawed to half thickness on band resaw, and grooved. These specifications can be met with a waste of less than 10 per cent in cutting.

* * * * * * * * * *

You are now to take Mr. Samson's place and explain why the present system of cost keeping gives inaccurate costs for box shooks, and to recommend a better system of cost accounting.

APPENDIX A

The Standing Expense Accounts

All moneys paid out for expenses, all supplies ordered by the various departments, all work done which does not apply directly to the cost of some particular job—all these items of expense find a place in the cost system and are properly distributed by being first charged to various standing expense orders or accounts.

Expenses are classified as to their nature and also as to the department on whose account the expense has been incurred. The following diagram presents a typical but by no means complete list of such accounts. One large company, for example, recognizes 195 different kinds of manufacturing expenses, and distributes each among several departments. This illustrates the extent of sub-

DESCRIPTION OF EXPENSE	Departmental Standing Expense Order Numbers							
	Central Office Supt'nce	Receiving Dep't	Power House	Loom Dep't	Beaming Dep't	Finishing Dep't		
Depreciation	100	200	300	400	500	600		
Insurance	101	201	301	401	501	601		
Rent and Taxes	102	202	302	402	502	602		
Fuel		203	303	403	503	603		
Purchased Power	104	204	304	404	504	604		
Mach'y Repair—Labor		205	305	405	505	605		
Mach'y Repair—Material		206	306	406	506	606		
Bld'g Repair—Labor	107	207	307	407	507	607		
Bld'g Repair—Material	108	208	308	408	508	608		
Watchman, etc.	109	209	309	409	509	609		
Sundry Supplies	110	210	310	410	510	610		
Salaries-Foremen		214	314	414	514	614		
Spoilage and Waste		219		419	519	619		
Machine Idle Time			331	431	531	631		

division necessary for accurate control of expenses in a large organization.

In the above table, the first digit in each account number is the number by which the department affected is known in the accounting department, while the other digits indicate the nature of the expense.

All withdrawal orders, work tickets, invoices, and the like, which cover expense items, show the appropriate standing expense order number. The number of the standing order is therefore in itself an aid in assembling these items of expense. They are grouped by departments so that total department expense can be compared with past expense. They are also grouped by the nature of the expense to show the totals spent for repairs, for supplies, and the like.

At the close of each month or year these departmental standing expense orders are closed into manufacturing expense.

APPENDIX B

IS INTEREST A MANUFACTURING EXPENSE?

Supposing an intricate labor-saving machine is purchased for $20,000, which will enable one man to do the work of three. Interest on this machine at 6 per cent will amount to $1,200. Overhead expense includes depreciation and insurance. Why have we not included interest also?

Many accountants do include interest on the amount invested in the plant as part of the overhead burden, and can present excellent reasons for so doing. We have not followed this practice for several reasons, two of the most important of which are as follows:

1. Interest on investment in plant equipment does not represent an actual cash expenditure, nor even the cash difference in values which is the basis for figuring a charge for depreciation. An interest charge would be only a bookkeeping entry, but if it were added to the overhead expense, it would increase the cost price of the inventory in exactly the same way as tho it were a money expense. Neither the banks nor the U. S. Income Tax Bureau will recognize interest as a part of the inventory value. Its inclusion therefore always raises a question when inventories are discussed with bank or tax officials.

2. The cost department can easily prepare supplementary statistics, by means of which the effect of interest in cost comparisons can be seen. Practically all that is necessary is to compute a set of supplementary burden rates for the interest item alone.

Appendix C illustrates the importance of interest when considering investment in labor-saving machinery.

APPENDIX C

THE PROFIT EARNED BY A LABOR-SAVING MACHINE

The extent to which it is profitable to add labor-saving devices, and the profits they earn, can be measured. The formula is:

Maximum justified investment = Yearly saving in operating expense, divided by the sum of the allowances for insurance, depreciation, maintenance, obsolescence, and interest on the investment (allowances expressed as percentages).

To compute the yearly savings, consider the savings in direct-labor cost and in the overhead burden on this labor, and the increase in earning power of the plant. Deduct from this the annual cost of power, supplies, etc. Then multiply the net full-time saving by the proportion of the working time that the device may be expected to operate.

Recently the magazine *Mechanical Engineering* quoted this formula and gave an example of its use. "Assume that the handling of miscellaneous materials about a factory, which has formerly been done by four men, receiving $3.50 a day each, or, allowing 300 days a year, at an annual direct cost of $4,200, can be done by one man operating an electric storage-battery industrial truck at a direct-labor cost of $1,050 per year, thus effecting a saving at the rate of $3,150 a year in direct-labor cost.

"Assume also that thru the greater promptness in moving materials and the more continuous operation of machines, there is an increase in earnings due to increased production, valued at $650 a year; also, that the labor involved, being counted as indirect, carries a fixed charge or burden of 10 per cent. In actual practice, the plant operates 240 days a year, or 80 per cent of the time. The various factors are estimated as follows:

Percentage allowance on investment	6
Percentage allowance for insurance and taxes	4
Percentage allowance for upkeep	20
Percentage allowance for depreciation and obsolescence	25
Yearly cost of power, supplies, etc.	$ 450
Yearly saving in direct cost of labor	$3,150
Yearly saving in burden on direct labor	$ 315
Yearly saving or earnings thru increased production	$ 650
Percentage of year during which equipment will be employed	80

The maximum justified investment will therefore be:

$$\frac{(\$3{,}150+\$315+\$650-\$450)\times 80\%}{(6\%+4\%+20\%+25\%)\text{ or }55\%}=\$5{,}331$$

"This indicates that equipment costing any sum below $5,331 will earn some profit above interest on investment, and maintenance.

"Assume that an electric storage-battery industrial truck will meet the condition stated, and that its cost will be $2,200. Then the yearly cost to maintain equipment ready for operation, exclusive of labor, will be $2,200×55%=$1,210. Then the profit from operation of the mechanical equipment becomes such $1,210 deducted from the saving on direct labor, $3,150, plus the yearly saving on fixed charges of $315, plus the yearly saving or earning thru increased production of $650, less the cost of supplies, power, and other items which are consumed of $450, all multiplied by factor of equipment use of 80 per cent. This leaves a profit of $1,722. The profit of $1,722 represents an annual earning upon the initial investment of $2,200 over all items of cost, of over 78 per cent."

APPENDIX D

Closing the Idle-Time Ledger

Assume that the machine-hour burden rates have been conscientiously figured on the basis of a high ratio of actual operating time based on normal plant capacity. The management is then indeed to be congratulated which does not find rather substantial balances in the Idle-Time Account, due to many reasons which may have kept machines idle, so that "they were not earning their keep."

What is to be done with these balances?

One method of disposition is to charge them directly into the Profit and Loss Account. This is entirely proper if the causes of idle time are beyond the control of the management—if, for example, there has been a strike or a transportation tie-up, or a general lack of business in this line.

Another school of cost accountants analyzes the account for its causes. Part may be charged to the shop administration for delays due to faulty planning, part to general administration for unbalanced orders, part to sales administration, and part to profit and loss. This plan effectively brings home the cost of idleness, but tends to unbalance comparative costs of all the departments of the business unduly.

Perhaps the best plan is to show idle-time balances as a distinct item in the final summarized statement of manufacturing cost. This item must then be backed up by a detailed statement of causes of idleness so arranged as to suggest where the mangement should go to obviate future idleness.

A cost accounting statement should not be regarded as a basis for "post mortems," but rather as a vital control and guide to management.